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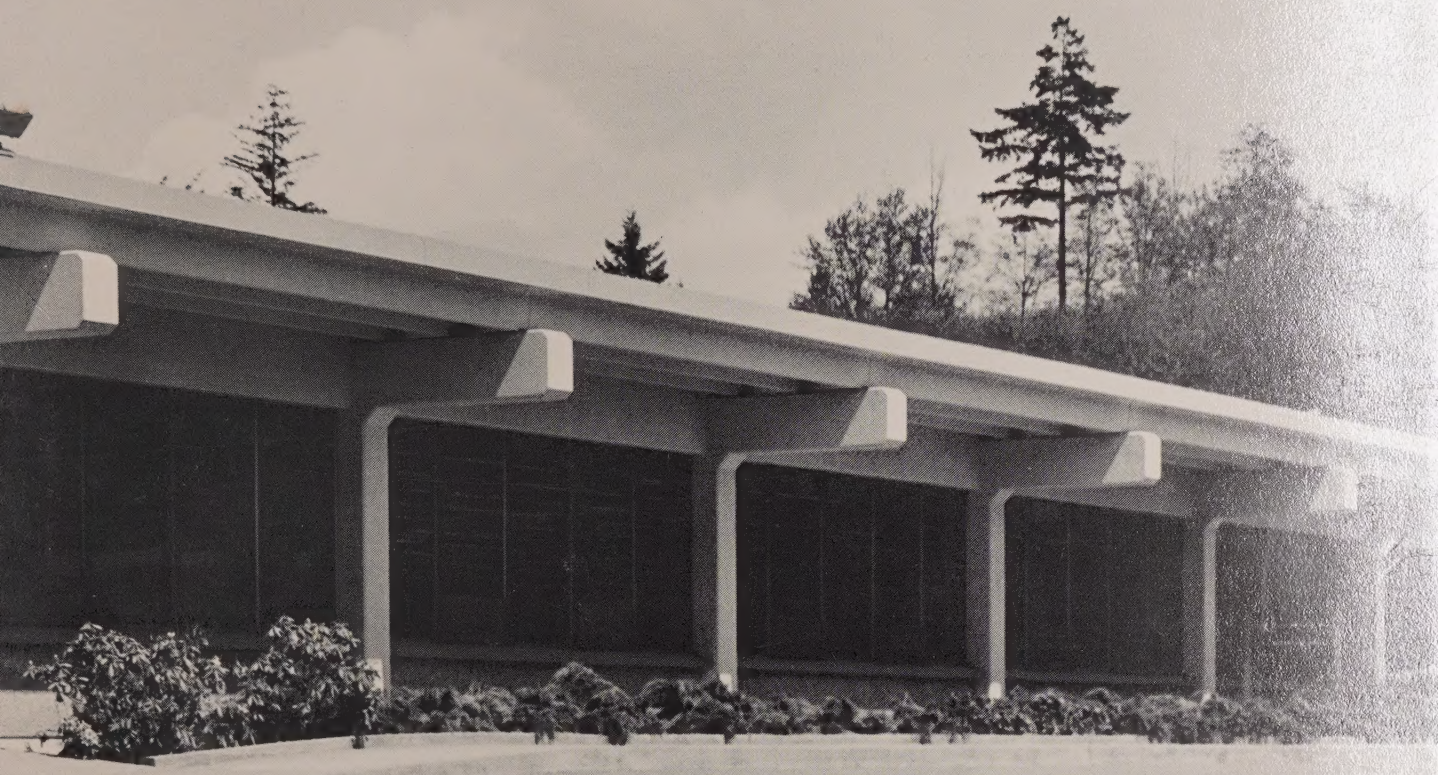
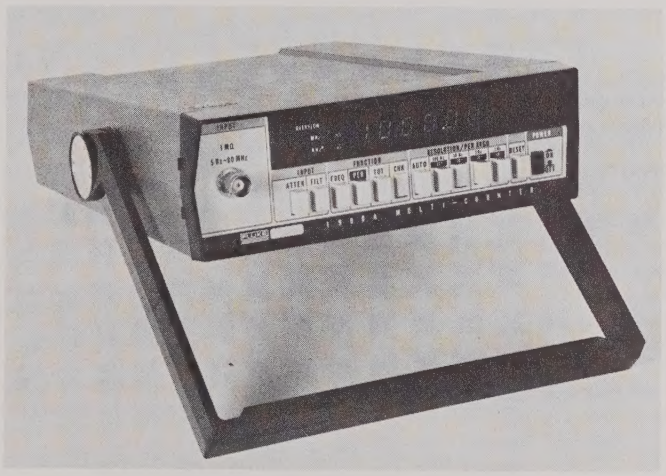
Instruction Manual



FLUKE®

JOHN FLUKE mfg. co., inc.
SEATTLE, WASHINGTON

JOHN FLUKE MFG. CO., INC.
P.O. Box 43210
Mountlake Terrace, Washington 98043



MODEL

1900A

MULTI–COUNTER

P/N 384875
January 1976

WARRANTY

The JOHN FLUKE MFG. CO., INC.* warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operations, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate will be made before the work begins, provided the instrument is not covered by the Warranty.

"The foregoing warranty is in lieu of all other warranties, express or implied, including but not limited to, any implied warranty of merchantability, fitness or adequacy for any particular purpose or use. Fluke shall not be liable for any special, incident or consequential damages."

SHIPPING

All shipments of John Fluke Mfg. Co., Inc.* instruments should be made via United Parcel Service or "Best Way"** prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc.* Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P.O. Box 43210, MOUNTLAKE TERRACE, WASHINGTON 98043*.

* For European customers: FLUKE (Nederland) B.V.
Ledeboerstraat 27
Tilburg, Netherlands

** For European customers, Air Freight prepaid.

CHANGE/ERRATA INFORMATION

MANUAL — TITLE: MODEL 1900A MULTI-COUNTER

ISSUE: Rev. 1 JANUARY 1976

Please make changes in this manual according to the following change and/or errata information:

ERRATA

Add the following warning after paragraph 2-17.

WARNING!

The outside contact of the BNC connector is tied to earth ground. DO NOT connect the active lead of input signals to the outside contact. Irrepairable damage to the 1900A may result.

Add the following information to Operating Temp, under GENERAL specifications on page 1-2:

0°C to 40°C, if battery option (–01) is being charged while the instrument is being operated.

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 1900A is a 5 Hz to 80 MHz multiple-function counter capable of making frequency, period, period averaging and totalize measurements. In the frequency mode, resolution is manually selectable at 0.1 Hz, 1.0 Hz, 10 Hz and 100 Hz. In the period averaging mode, the number of periods averaged is manually-selectable at 10^0, 10^1, 10^2 and 10^3 periods. Automatic selection of resolution and number of periods averaged (autoranging) is also provided to automatically select the optimum range for a particular input signal.

1-3. The measurement display is six digits, light-emitting-diode-type (LED) with leading-zero suppression and automatic decimal point positioning. Annunciators are provided to indicate measurement units (kHz, MHz, milliseconds and microseconds) and also overflow when the capacity of the display is exceeded. All displayed information is also available, in parallel BCD format, at a rear-panel connector when the unit is equipped with an optional Data Output Unit (DOU).

1-4. The Model 1900A is equipped with a selectable 1 MHz low-pass filter for use in electrically noisy environments, and a selectable 10:1 attenuator for use with high-level inputs. A self-check mode of operation is provided to verify overall performance of the unit. Power requirements are 100, 115 or 230 volts at 50 to 400 Hz for the line-powered version. An optional battery-powered version, Model 1900A–01, provides for use away from ac power lines and is equipped with rechargeable nickel-cadmium batteries. The battery-powered version also operates from the ac lines, but only at the power line frequency and voltage specified on the bottom of the instrument.

1-5. SPECIFICATIONS

1-6. The pertinent specifications for the Model 1900A are listed in the following Table 1-1.

Table 1-1. MODEL 1900A SPECIFICATIONS

OPERATING RANGES

Frequency:
5 Hz to 80 MHz

Period:
5 Hz to 1 MHz single and multiple period averages

Totalize:
1 count to 999999 counts

INPUT CHARACTERISTICS

Sensitivity:
25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz
Frequency and totalize: 200 mV P-P pulse amplitude with minimum pulse width of 20 nsec. Duty cycle $>$ 10%.
Period: 200 mV P-P pulse amplitude with minimum pulse width of 200 nsec. Duty cycle $>$ 10%.

Impedance:
1 MΩ shunted by less than 30 pf

Filter:
1 MHz (3dB point) lowpass

Attenuator:
Decreases sensitivity by 10

Overload:
150V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

RESOLUTION

Frequency:
Four manually selected gate times of:
10ms (100 Hz resolution)
100ms (10 Hz resolution)
1s (1 Hz resolution)
10s (0.1 Hz resolution)

Autorange position will automatically seek to fill all 6 digits but will not select a gate time greater than 1 second (1 Hz resolution)

Period:
Manual selection of single period or 3 period averaging ratios:
10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position will automatically seek to fill all 6 digits. Autoranging will not select a period average of greater than 10^2 averages.

Totalizing:
Accumulates up to 999999 counts, then activates overflow indicator.

TIME BASE CHARACTERISTICS

Frequency:
10 MHz

Stability:

Aging Rage:	$<\pm5 \times 10^{-7}$ month
Short Term:	$<\pm5 \times 10^{-8}$ rms over 1 second
Temperature:	$<\pm5 \times 10^{-6}$ 0°C to 50°C
	$<\pm2 \times 10^{-6}$ (typical) 20°C to 30°C

Line Variation:
$<\pm1 \times 10^{-7}$ for ±10% variation in line voltage

GENERAL

Display:
6 digit LED, leading zero suppression
Time between successive measurements is 200 ms plus measurement time

Annunciation:
MHz, kHz, msec, μs overflow

Automatic Features:
AUTORANGE:
In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds, to eliminate redundant up range/down range commands. This allows measurements to be made on signals containing large amounts of FM and PM.
Hysteresis memory can be reset by depressing the reset button.
AUTORESET:
A new measurement sequence is started every time a front panel button is activated.

Operating Temp: 0°C to +50°C

Storage Temp: –40°C to +60°C

Power Requirements:
115/230 VAC ±10% - 100 VAC available - 50, 60, 400 Hz - 6.5 watts line model - 8.5 watts battery model

Fuses:
1/8A AC-line version-½ A slo-blo battery version

DIMENSIONS

Width:	8.55 inches	217.2 mm
Height:	2.52 inches	64.0 mm
Depth:	10.65 inches	270.5 mm
Weight:	2.75 lbs	1.2 Kg

DATA OUTPUT OPTION

8-4-2-1 BCD output from each digit, plus encoded decimal point and units annunciation information. All outputs CMOS/Low Power TTL compatible, high true. Print command is provided.

BATTERY

NICAD rechargeable - discharge time 5 hours - charge time 14 hours with unit inoperative

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating information for the Model 1900A. The contents of this section should be read before operating the counter. Should any difficulties arise during operation of this instrument, please contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co. Ltd., 2247 Midland Avenue, Scarborough, Ontario, M1P 4R1. A list of Sales Representatives is located at the rear of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 1900A is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co. Please reference the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The Models 1900A and 1900A–01 are supplied with one of three ac input power configurations. These consist of 100Vac, 115Vac and 230Vac; at 50 to 400 Hz. Before connecting to the ac line power, insure that the instrument is in the proper configuration for your power lines. A decal on the underside of the instrument indicates the ac line voltage and frequency required.

CAUTION

The battery-powered version must be operated at the line frequency stamped on the bottom-panel decal.

2-8. RACK INSTALLATION

2-9. The Model 1900A may be mounted in a standard 19-inch rack when supplied with the appropriate rack mounting kit. Rack mounting kits are available to allow left, right or center mounting. Instructions for installing units in the rack mount are supplied with the rack mounting kit. These instructions are repeated in Section 6. The center rack mounting kit is Model No. M00-200-612. The offset rack mounting kit is Model No. M00-200-611.

2-10. OPERATING FEATURES

2-11. The location and function of all controls, connectors, and indicators are shown in Figure 2-1. Operating features and instructions for accessories are discussed in Section 6.

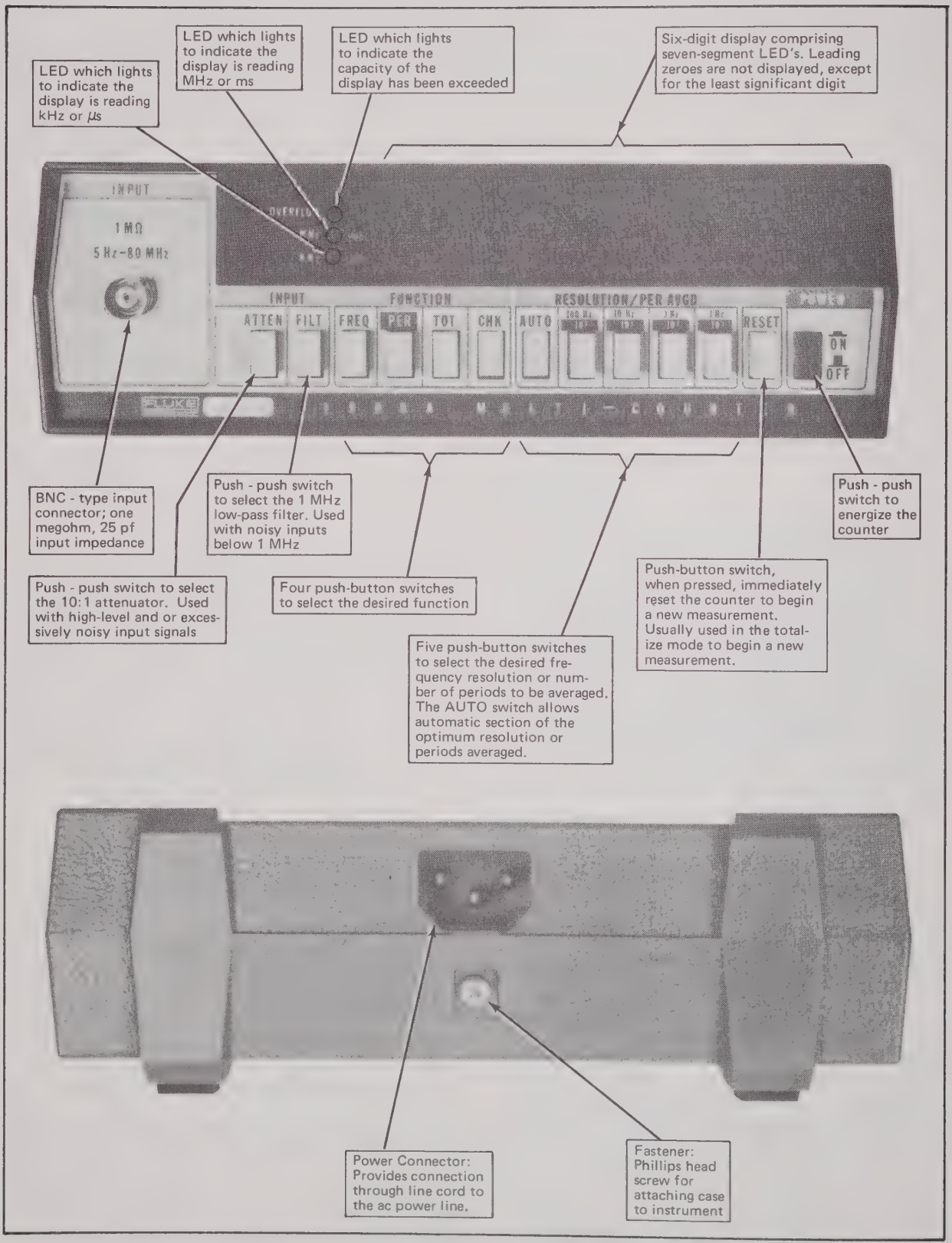
LED which lights to indicate the display is reading kHz or μs
LED which lights to indicate the display is reading MHz or ms
LED which lights to indicate the capacity of the display has been exceeded
Six-digit display comprising seven-segment LED's. Leading zeroes are not displayed, except for the least significant digit
INPUT
1 MΩ
5 Hz-80 MHz
OVERFLOW
INPUT
ATTEN
FILT
FUNCTION
FREQ
PER
TOT
CHK
RESOLUTION/PER AVGD
AUTO
RESET
ON
OFF
BNC - type input connector; one megohm, 25 pf input impedance
Push - push switch to select the 1 MHz low-pass filter. Used with noisy inputs below 1 MHz
Push - push switch to select the 10:1 attenuator. Used with high-level and or excessively noisy input signals
Four push-button switches to select the desired function
Five push-button switches to select the desired frequency resolution or number of periods to be averaged. The AUTO switch allows automatic section of the optimum resolution or periods averaged.
Push-button switch, when pressed, immediately reset the counter to begin a new measurement. Usually used in the totalize mode to begin a new measurement.
Push - push switch to energize the counter
Power Connector: Provides connection through line cord to the ac power line.
Fastener: Phillips head screw for attaching case to instrument

Figure 2-1. CONTROLS, CONNECTORS AND INDICATORS

2-12. OPERATING NOTES

2-13. Fuse

2-14. The line fuse, F1, is located inside the case near the power transformer. To gain access to this fuse, remove the retaining screw at the rear of the instrument case, and remove instrument from case.

2-15. Input Connection

2-16. Signals to be measured by the Model 1900A are applied to the front-panel BNC connector. Connection of all input signals should be by means of coaxial-type cable fitted with a mating BNC connector. Input impedance is one megohm shunted by 25 pf. Input sensitivity is 25 millivolts rms.

2-17. Overload Protection

2-18. The Model 1900A will accept inputs as high as 150 volts rms at frequencies below 1 kHz without damage. Overload capability decreases linearly from 150 volts rms at 1 kHz to 20 volts rms at 80 MHz input, as illustrated in Figure 2-2.

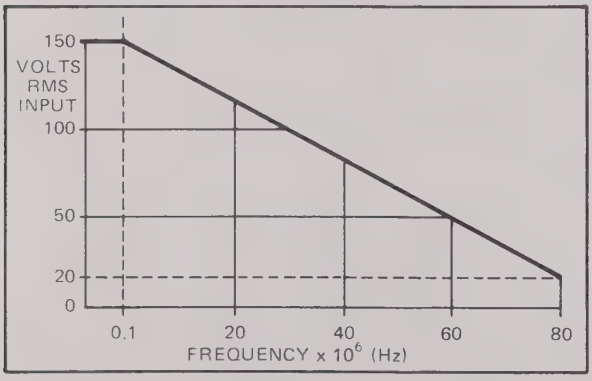

Figure 2-2. INPUT OVERLOAD PROTECTION LEVELS

2-19. FREQUENCY MEASUREMENTS

2-20. Perform frequency measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the FREQ switch to select the frequency mode of operation.

c. Select the desired resolution, or the autorange mode by pressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum range.

NOTE

In the autorange mode, automatic selection is made between the lower three resolutions. The 0.1 Hz resolution can only be manually selected (by means of the .1 Hz RESOLUTION switch).

d. Connect the input signal to the front-panel BNC connector. If the input signal is high level (refer to Figure 2-2 for acceptable input levels), press the ATTEN switch to reduce the input sensitivity by a factor of 10:1.

e. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

f. Read the frequency on the display, and observe the unit of measurement indication (kHz or MHz) to the left of the display.

2-21. PERIOD MEASUREMENTS

2-22. Perform period measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the PER switch to select the period mode of operation

c. Select the desired number of periods to be averaged, or the autorange mode by pressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum number of periods to average.

NOTE

In the autorange mode, automatic selection is made between 10^0, 10^1 and 10^2 periods to be averaged. The 10^3 (1000) periods averaged can only be manually selected (by means of the 10^3 PER AVGD switch).

d. Connect the input signal to the front panel BNC connector. If the input signal is high level (refer to Figure 2-2 for acceptable input levels), press the ATTEN switch to reduce the input sensitivity by a factor of 10:1.

e. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

f. Read the period time on the display, and observe the unit of measurement indication (ms or μs) to the left of the display.

2-23. TOTALIZE MEASUREMENTS

2-24. Perform totalize measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the TOT switch to select the totalize mode of operation, and the RESET switch to initialize the counter.

c. Connect the input signal to the front-panel BNC connector. If the input signal is high level (refer to Figure 2-2 for acceptable input levels), press the ATTEN switch to reduce the input sensitivity by a factor of 10:1.

d. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

e. Read the accumulated total on the display.

2-25. SELF-CHECK MODE

2-26. The self-check mode provides a means of verifying proper overall operation of counter, excluding input amplifier, attenuator and filter. To self-check the unit, proceed as follows:

a. Press the POWER switch to the ON position.

b. Press the CHK switch to select the self-check mode.

c. Press the 100 Hz RESOLUTION switch; the display should read 1.0000 MHz.

d. Press the 10 Hz RESOLUTION switch; the display should read 1000.00 kHz.

e. Press the 1 Hz RESOLUTION switch; the display should read 000.000 kHz, and light the OVFL annunciator.

f. Press the AUTO switch; the display should read 1000.00 kHz.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description of the Model 1900A, followed by a more detailed block diagram analysis. Simplified block diagrams are included as necessary, to supplement the text.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Frequency Mode

3-5. Generally, the frequency of any signal is measured by counting the number of cycles of the unknown signal for a known length of time, referred to as the gate time. Gate time is usually equal to seconds at some power of ten, i.e. one millisecond, ten milliseconds, etc. The longer the gate time, the greater the measurement resolution. The accumulated count of the input signal cycles is then fed to the display section where it is observed by the operator.

3-6. As shown in Figure 3-1, the Model 1900A comprises an input section, a main gate, decade counters/display memory/display multiplexer, display light emitting diodes, a time base oscillator, range control logic/time base dividers and program control logic. The unknown signal is applied to the input section where it is limited, amplified and shaped to a squarewave for application to one input of the main gate. The input section also contains a selectable 1 MHz low-pass filter and a selectable 10:1 attenuator.

3-7. In order for the input signal to be applied to the decade counters, a main gate enable signal is required at the second input of the main gate. The main gate enable signal is derived from the 1 MHz output of the time base oscillator/divider. The 1 MHz time base signal is applied to the range control logic and time base dividers, where it is divided by a factor of 10^4, 10^5, 10^6 or 10^7, depending upon which range (degree of resolution) is selected. If the 100 Hz resolution is selected, then the time base oscillator output is divided by a factor of 10^4 to yield a time base having a period of 10 milliseconds (0.01 seconds). For a time base of 100 milliseconds, a division factor of 10^5 is used, and so on.

3-8. The divided time base signal is applied to the main gate and enables the signal under measurement to pass through to the six series-connected decade counters for one full period of the divided time base. The decade counters continue to accumulate the gated pulses from the input signal as long as the main gate enable signal is present (i.e. for the period of the time base). At the end of the time base period, the main gate is inhibited and the counters no longer receive input pulses. At this time, the program control logic issues a memory update command to the display memory, causing the contents of the six decade counters to be stored in six memory units until the next memory update command occurs.

3-9. There are six decade counters, six four-bit memory units and six display light-emitting diodes (LED'S). However, the contents of only one memory unit (one digit of measurement data) is displayed on its corresponding LED at any given time. A display multiplexer sequentially places the contents of each memory unit on a measurement data bus for a period of approximately 90 microseconds.

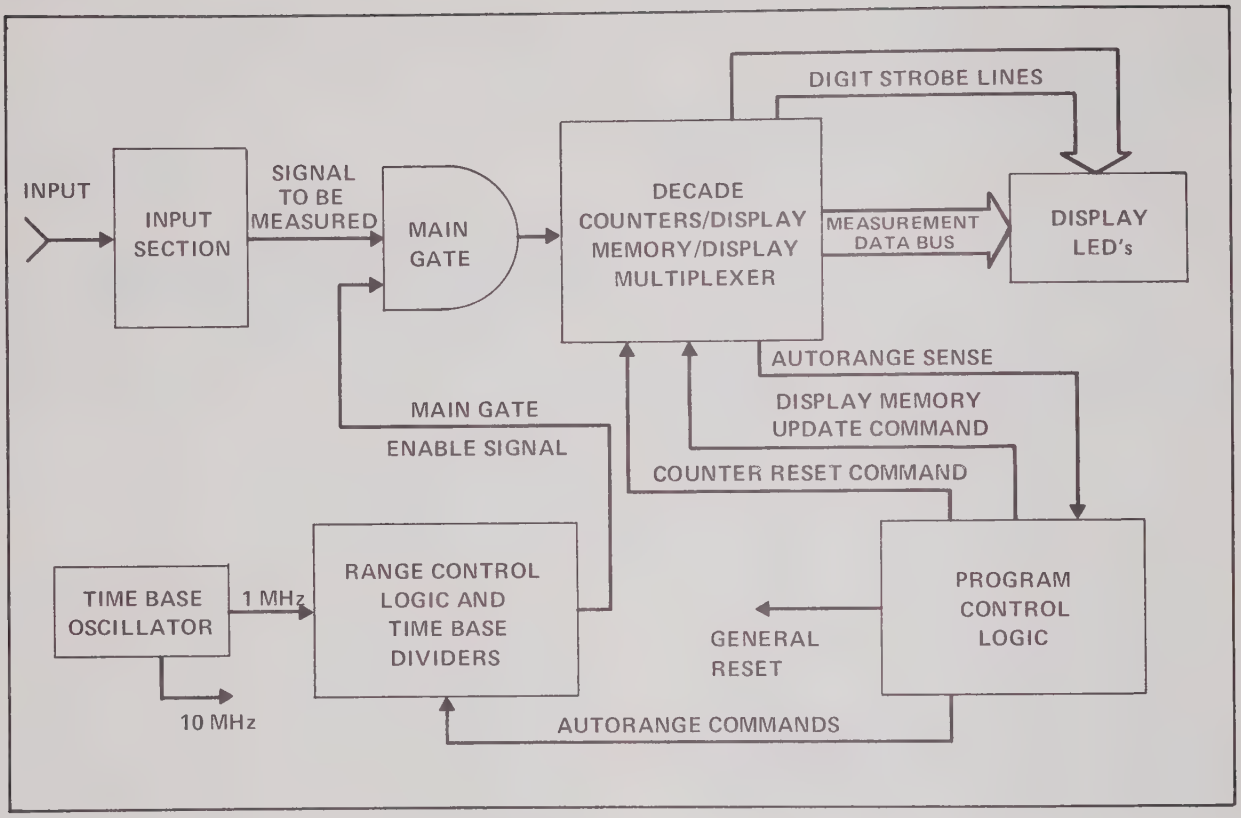

Figure 3-1. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – FREQUENCY MODE

The measurement data bus is commonly connected to all digits (LED'S) in the display. However, only that digit which corresponds to the memory unit being gated is enabled by means of a strobe line. As the next memory unit is gated onto the measurement data bus, the next digit is strobed to display that data. As each memory unit is gated, the corresponding LED is strobed to display the data placed on the measurement data bus, resulting in a scanning action of the display. By sequencing through the display memory and lighting each LED for only 9% of the time, power consumption is minimal. Persistence of the eye eliminates any effects of blinking or flicker.

3-10. While the last measurement is being displayed, the program control logic initiates the next measurement by generating a general reset command, to initialize various elements of the control logic. The general reset command is also used to reset the six decade counters back to zero in preparation for the next measurement.

3-11. Period Mode

3-12. The period of an unknown signal is measured by counting a known frequency during 1, 10, 100 or 1000 periods of the unknown input. Figure 3-2 shows how the Model 1900A uses the 10 MHz output of the timebase oscillator as the known frequency used to record time, while the unknown input is fed to the time base dividers to enable and inhibit the main gate.

3-13. In the period mode, the unknown input signal is used to enable the main gate at the beginning of a cycle. The decade counters accumulate the 10 MHz time base oscillator output during the time the main gate is enabled. At the beginning of a succeeding cycle of the input signal, the main gate is inhibited, and the decade counters cease to accumulate the 10 MHz time base signal. The contents of the counters indicate the elapsed time between successive cycles of the input signal. Depending upon the PER AVGD switch selection, the number of periods of the input signal used to enable and inhibit the main gate may be 1, 10, 100 or 1000. The more periods averaged, the better the resolution of the measurement.

3-14. The period information is transferred from the decade counters to the display memory by the program control logic. While stored in the memory, the period measurement is displayed in the same manner as previously described for the frequency mode of operation.

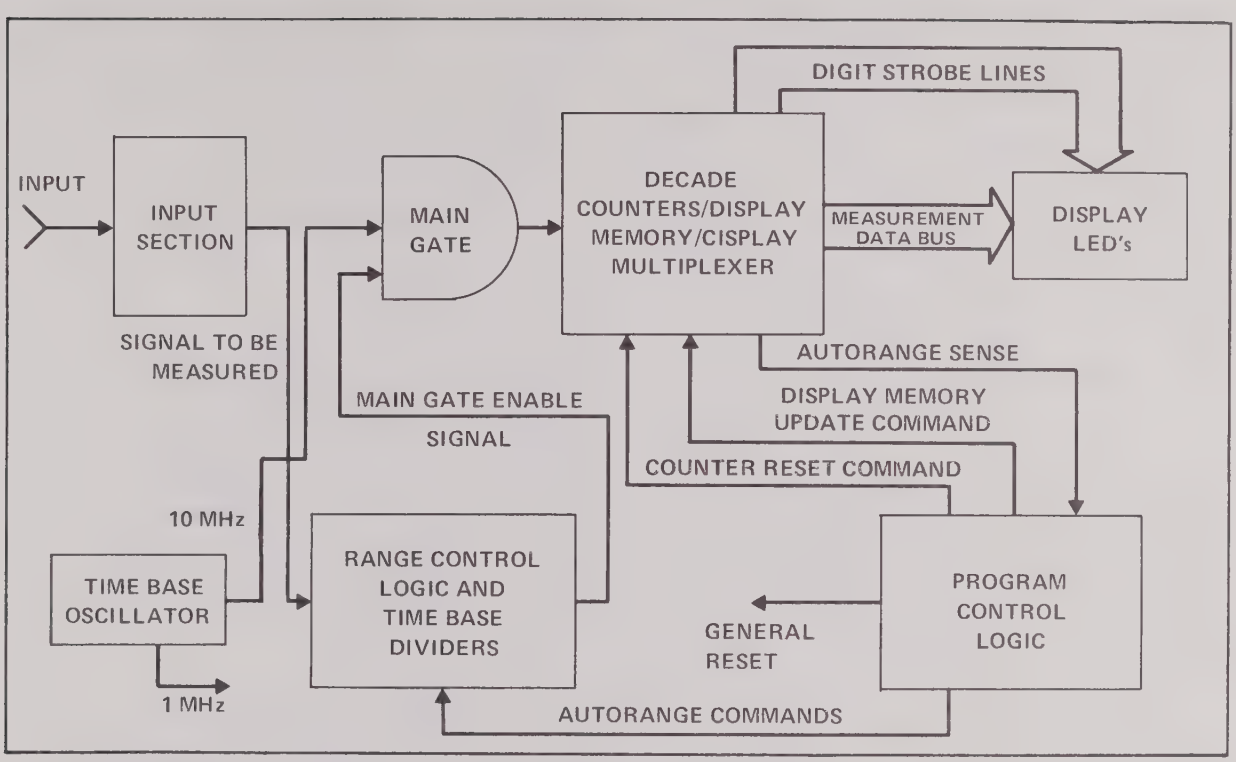

Figure 3-2. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – PERIOD MODE

3-15. Totalize Mode

3-16. The configuration of the 1900A in the totalize mode is shown in Figure 3-3. In this mode, no time base signals, range control or control logic is used, since totalize is basically a manual operation. Operation is initiated by means of a manual reset command which resets all decade counters to zero. From this time, all input pulses, either random or uniform, are gated through to the decade counters due to the continuous main gate enable signal provided by the front-panel totalize switch.

3-17. As the decade counters accumulate the input pulses, their contents are continuously applied to the dis-

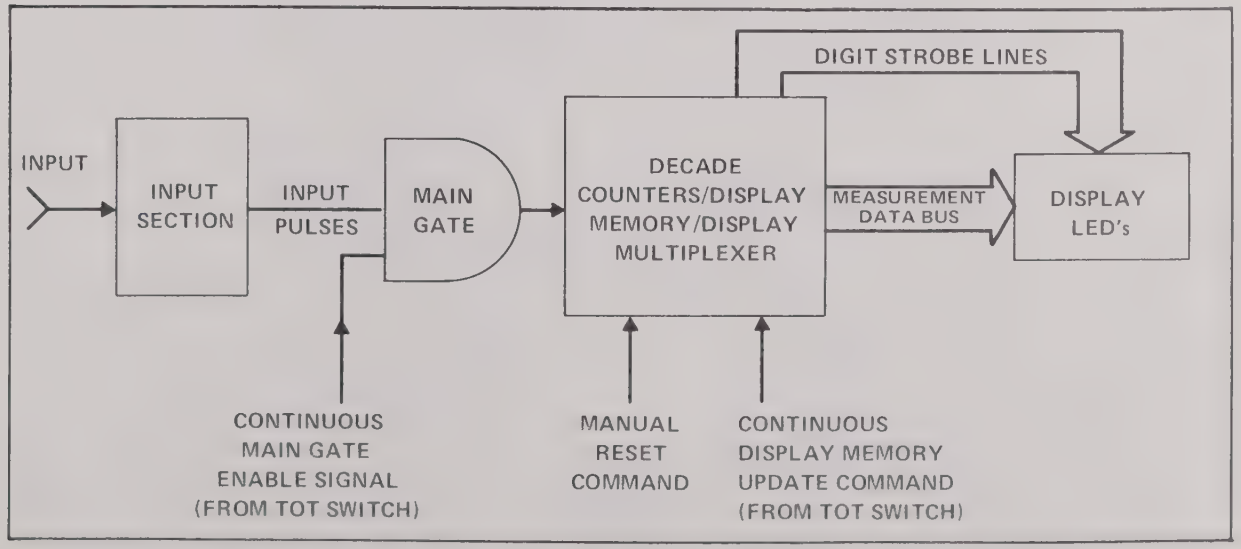

Figure 3-3. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – TOTALIZE MODE

play memory due to the continuous display memory update command provided by the front panel totalize switch. As a result, the accumulated total is displayed at all times.

3-18. Self-Check Mode

3-19. Operation of the 1900A in the self-check mode is similar to that previously described for the frequency mode except that the unknown input is replaced by the 1 MHz output of time base oscillator. Refer to Figure 3-4.

3-20. Power Supply

3-21. LINE POWER

3-22. The line power supply provides regulated voltages of –12V dc and +5V dc and an unregulated +5V dc. The –12V dc is used as operating power for the input section, display multiplexer and logic control. The positive logic level voltage, used throughout the unit, is provided by the +5V dc power supply. The unregulated +5V dc is used to supply power for the digit drivers Q2 – Q7.

3-23. BATTERY POWER

3-24. When the battery power option is installed in the unit all operating voltages are derived from the +5V battery output voltage. The battery supplies the +5V positive logic voltage and digit driver voltage directly and produces the –12V dc power through a dc-to-dc power converter. The ac power line input is first rectified then applied to the battery as charging voltage.

3-25. BLOCK DIAGRAM ANALYSIS

3-26. Input Section

3-27. The function of the input section is to condition all input signals prior to application to the main gate. As shown in Figure 3-5, the signal to be measured, when applied to the input connector, is fed through buffer amplifier, Q1 and Q2. Resistors R6 and R7, connected to the collector of Q2, form a 10:1 attenuator controlled by Q3 and Q4. In the x1 position the ATTEN switch causes Q3 to conduct and pass the input signal unattenuated, while in the X10 position Q4 conducts and passes only one-tenth of the input signal.

3-28. After passing through the attenuator the signal can then be filtered if desired. The filter consists of C6, CR7 and CR8, C3 and R10. The FILT switch on the front panel applies +5V dc to R10, when the filter is selected (in), to forward bias the diodes CR7 and CR8. Input

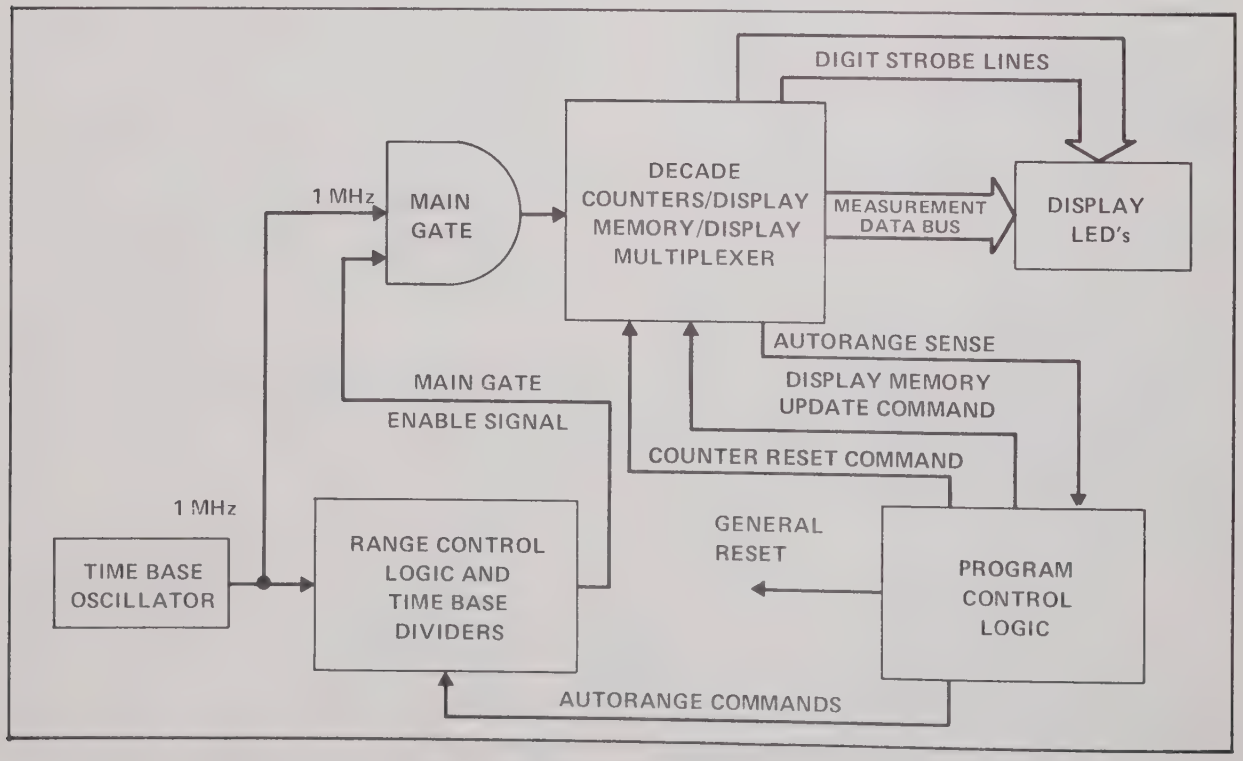

Figure 3-4. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – SELF-CHECK MODE

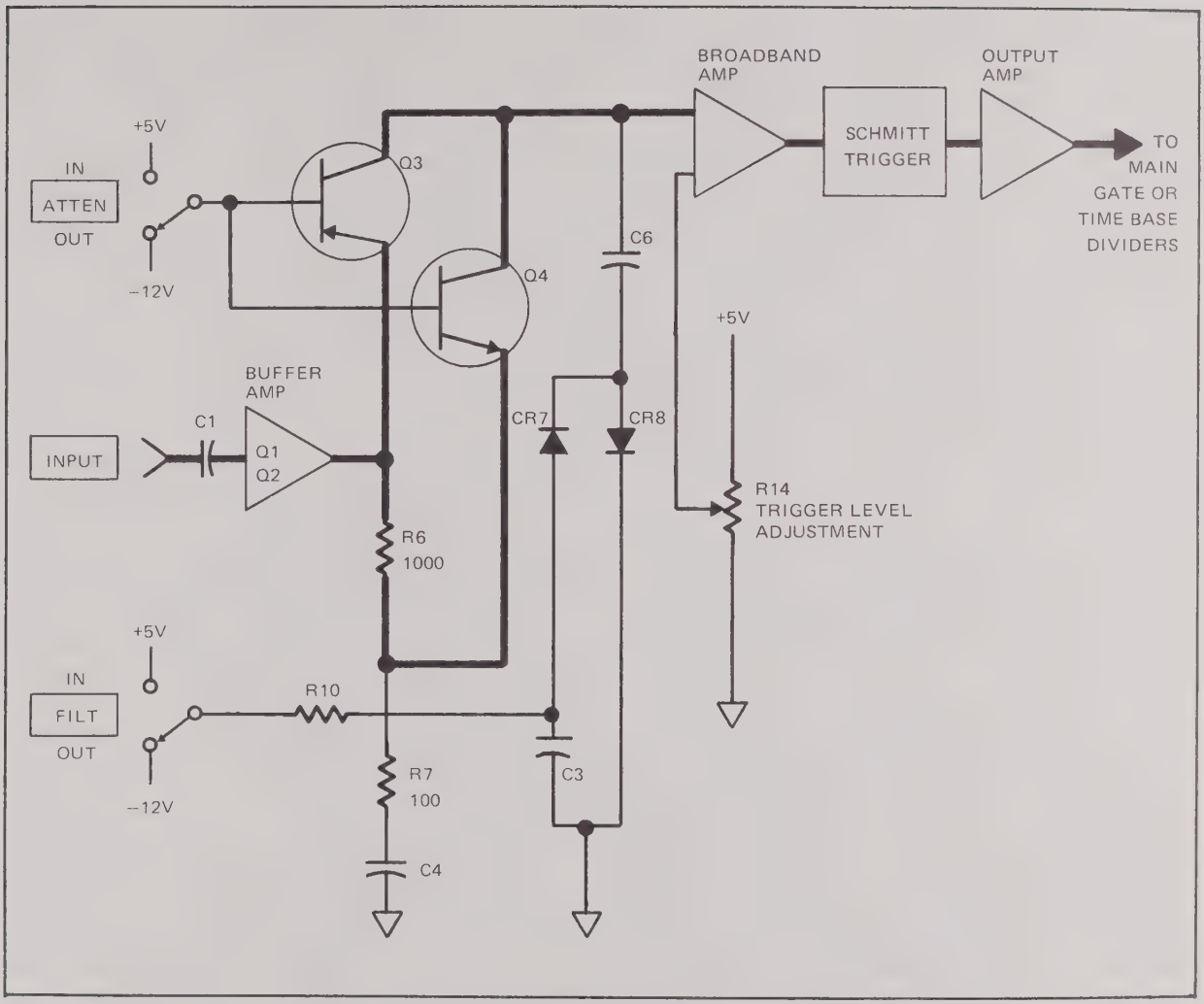

Figure 3-5. INPUT SECTION, BLOCK DIAGRAM

signals above 1 MHz are then shunted to ground through C6 and CR8. When the filter is out the −12V dc applied to R10 reverse biases the diodes allowing all input frequencies to pass.

3-29. Several stages follow the filter. A buffer amplifier precedes the trigger level adjustment in conjunction with R14. A succeeding broadband amplifier provides gain over the wide range of input frequencies and feeds the Schmitt trigger. The Schmitt trigger squares the input signal and feeds it to the output amplifier which translates the signal to standard TTL levels for application to the main gate (frequency and totalize modes) or time base dividers (period mode).

3-30. Main Gate/Decade Counters

3-31. The main gate is an integral part of the first of the six decade counters, as shown in Figure 3-6. The gating of input pulses to the decade counters from the input section (frequency and totalize modes) or time base dividers (period and self-check modes) is accomplished by applying an enable signal to the J and K inputs of the first stage of the first decade counter. Since the input pulses are applied to the clock input of the first stage, the J and K inputs must be true in order for the input pulses to toggle the first stage, which in turn, toggles the subsequent stages.

NOTE

Four of the six decade counters, the display memory, the display multiplexer and measurement data bus described in these paragraphs are contained in U24, and are not separately replaceable for the purpose of repair.

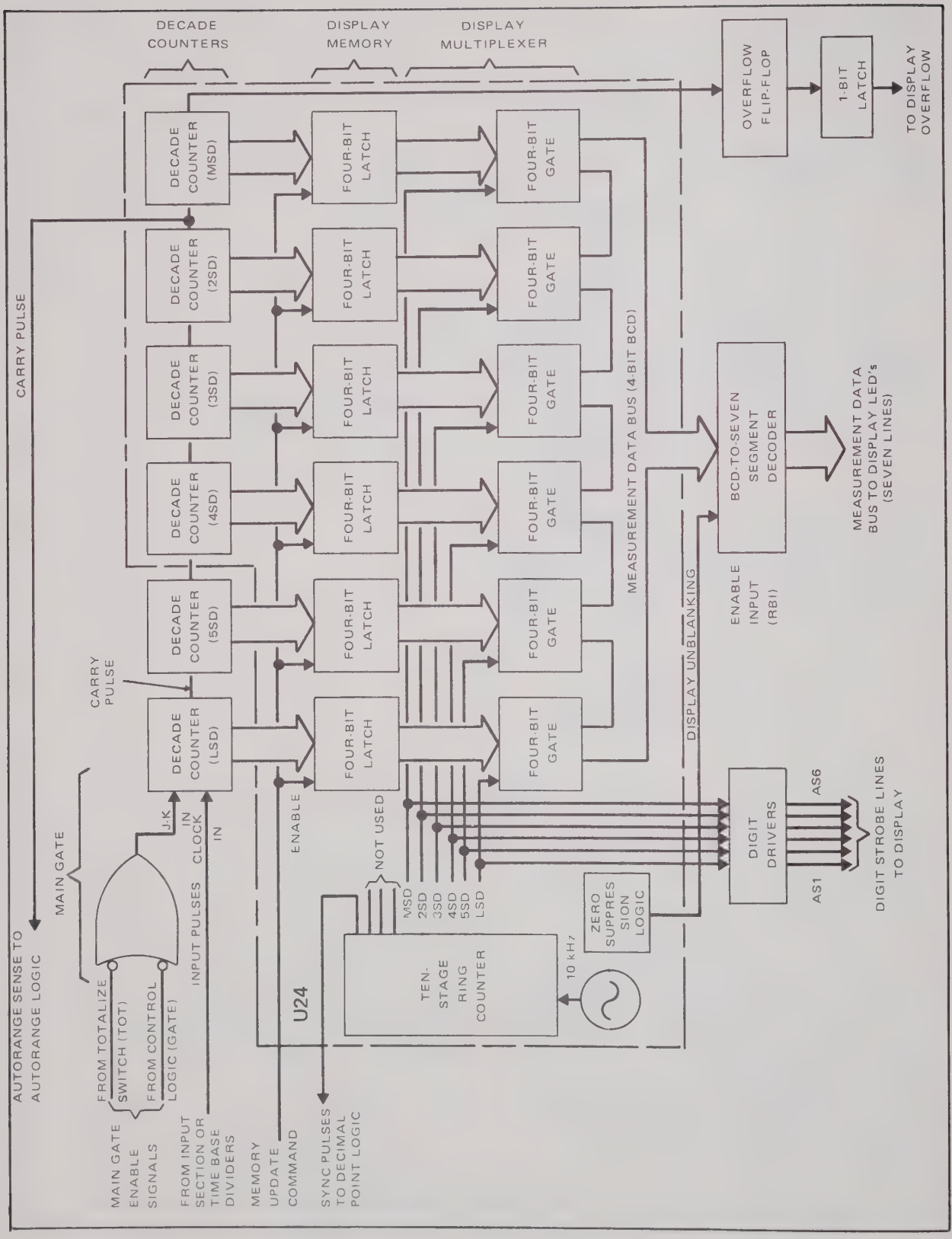

Figure 3-6. DECADE COUNTERS, DISPLAY MEMORY & DISPLAY MULTIPLEXER, BLOCK DIAGRAM

3-32. The main gate is enabled by the application of either of two commands; one generated by the TOT switch when in the totalize mode, and the other generated by the control logic in all other modes of operation. When enabled, the first decade counter (least significant digit) receives the input pulses, and issues a carry pulse to the succeeding decade counter (fifth significant digit). The carry output of each counter becomes the input to the succeeding counter. The carry output of the most significant digit decade counter is used to generate the overflow signal, which lights the OVFL indicator. The overflow signal becomes true whenever the MSD counter exceeds full count and wraps-around back to zero (i.e. on the trailing edge of the carry pulse).

3-33. Display Memory

3-34. The function of the display memory, shown in Figure 3-6, is to store the BCD contents of the decade counters after the measurement has been made, so that the multiplexer has access to settled data at all times. Without the display memory, the display would directly reflect the counting action of all the decade counters making it difficult to observe the final measurement. In the totalize mode, the display memory is not used and the contents of the counters at any given time, are displayed on the LED's.

3-35. The display memory comprises a set of six four-bit latches which accept their applied BCD inputs during the presence of a memory update command. The memory update command is generated by the control logic when it has determined that the contents of the decade counters are ready for display. (The control logic is described later in this section).

3-36. Display Multiplexer

3-37. The function of the display multiplexer is to sequentially gate each digit of measurement data from the outputs of the display memory onto a bus which is commonly connected to all display LED's. In conjunction, the display multiplexer also enables the corresponding LED at the same time its respective measurement data is placed on the bus. As shown in Figure 3-6, the Display multiplexer comprises a series of six four-bit gating circuits, a 10 kHz oscillator, a ten-stage ring counter and a measurement data bus (four-bit BCD). The 10 kHz oscillator drives the ten-stage ring counter through a complete cycle every millisecond. Each output is true for a period of 90 microseconds, providing a 10 microsecond guard period between each output.

3-38. Six of the ring counter outputs are used to enable the six four-bit gating circuits, and their corresponding display LED's. Three outputs are not used, and the tenth output is used to reset the zero suppression logic. As the ring counter progresses through its cycle, each of the gating circuits is sequentially enabled for a period of 90 microseconds to place its respective digit of measurement data on the measurement data bus for application to the display LED's. At the same time the digit of measurement data is placed on the bus, the ring counter output feeds the digit strobe line, via the corresponding LED drivers, to enable the corresponding display LED. Refer to Figure 3-7.

3-39. Prior to application to the display, the BCD measurement data is decoded to the seven-line format required by the display LED's. The digit strobe lines are fed through a series of drivers for application to the anodes (enable inputs) of the display LED's.

NOTE

The BCD-to-seven segment decoder is inhibited by zero suppression logic whenever non-significant leading zeroes are placed on the measurement data bus.

3-40. Decimal Point Logic

3-41. The position of the decimal point in the display is determined by the decimal point logic shown in Figure 3-8. The range information is applied to a pair of storage flip-flops, and is updated by the memory update command which is synchronized by a ring counter output of the display multiplexer by means of U11. The outputs of the flip-flops reflect the current operating range and are fed to a series of AND gates which, in conjunction with three of the digit strobe lines, decode the decimal point position to a particular LED in the display. In the totalize mode, the decimal point logic output is disconnected from the decimal point bus by means of the TOT switch.

3-42. Time Base Oscillator

3-43. The time base oscillator provides the main gate time base in the frequency and self-check modes, and provides the input signals to the decade counters in the period and self-check modes. The oscillator, shown in Figure 3-9, is a crystal controlled Colpitts which operates at 10 MHz. The 10 MHz signal is squared by Q15 and U17, and applied to a decade counter, U12, to obtain an output of 1 MHz. Both outputs are fed through the front-panel function switches to various sections of the counter.

3-44. Time Base Dividers

3-45. The function of the time base dividers, shown in Figure 3-10, is to divide the 1 MHz time base oscillator

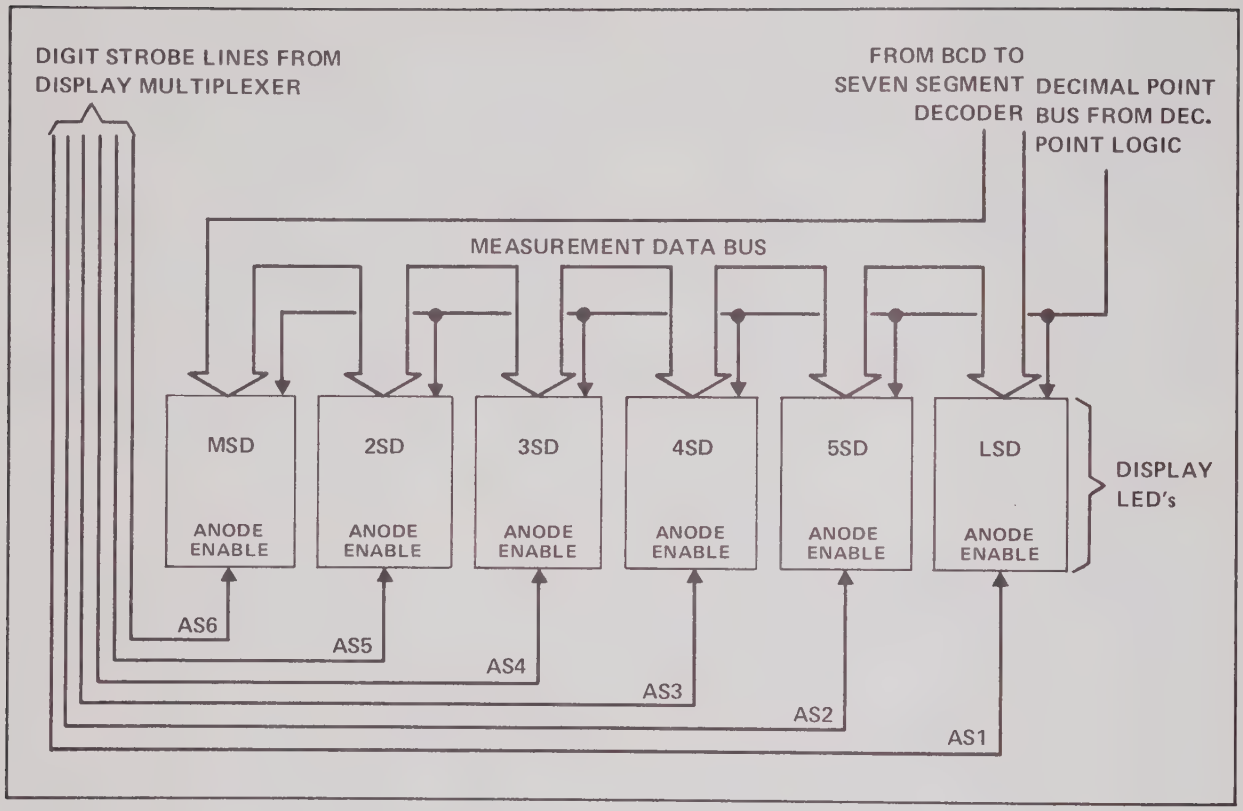

Figure 3-7. DISPLAY SECTION, BLOCK DIAGRAM

output (in modes other than period) or signal output from the input section (period mode) by a selected power of ten to obtain the proper main gate enable signal. The time base dividers are contained within a single integrated circuit which receives division commands from the iteration counter within the range control logic. Table 3-1 lists the eight different combinations of division commands, hereafter called range coding, and the corresponding division factors provided by the dividers for the time base output. For example, an input to the dividers of 1 MHz with a true signal on the RNG2 and false signals on the RNG1 and RNG0 range code lines, the time base output would be 100 Hz and have a period of 10 milliseconds.

3-46. Control Logic

3-47. The control logic, shown in Figure 3-10, controls the sequence of events which take place throughout the counter in order to take a measurement and display it. The control logic sequences through the measurement cycle at a rate controlled by a 100 Hz relaxation-type oscillator. The measurement cycle consists of the following basic steps:

a. A general reset command is issued to initialize the control and autorange logic.

b. The main gate is enabled for a period of time which corresponds to the selected resolution. During this time, the decade counters accumulate the input pulses passed by the main gate. Also, the 100 Hz oscillator and the control logic is inhibited during this time to reduce the amount of electrical noise within the unit during the actual measurement.

c. At the end of the main gate time, the main gate is inhibited and a memory update command (MUP) is issued to load the display memory with the contents of the decade counters when in the manual range mode. In the auto range mode, the measurement will be repeated on the next higher range until the requirements of the autorange logic are met. At that time, the MUP command will be generated.

d. The iteration counter in the autorange logic is reset.

3-48. The following discussion describes the measurement cycle with reference to Figure 3-10. As a starting point, assume the sequencer, comprising a BCD decade counter

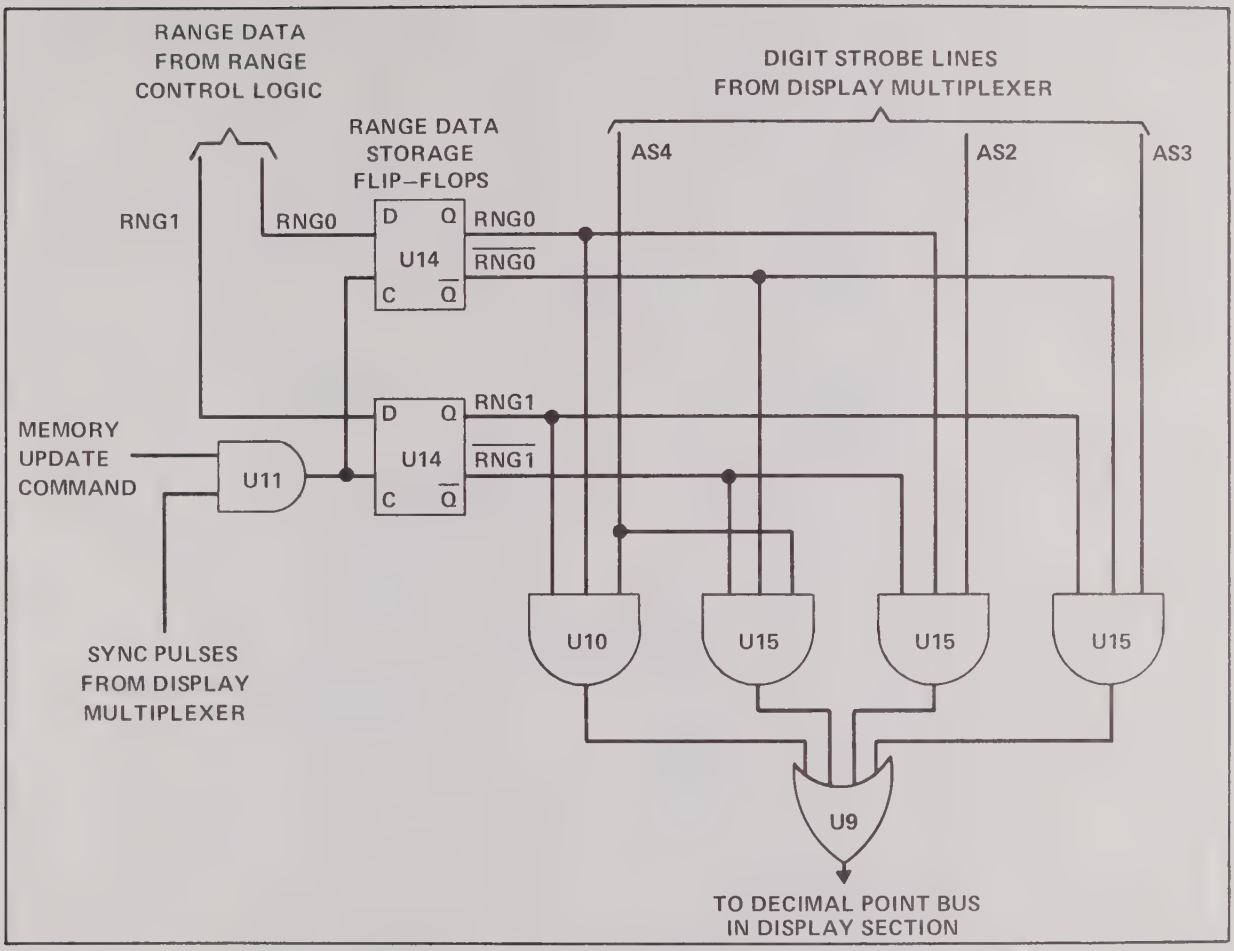

Figure 3-8. DECIMAL POINT LOGIC, BLOCK DIAGRAM

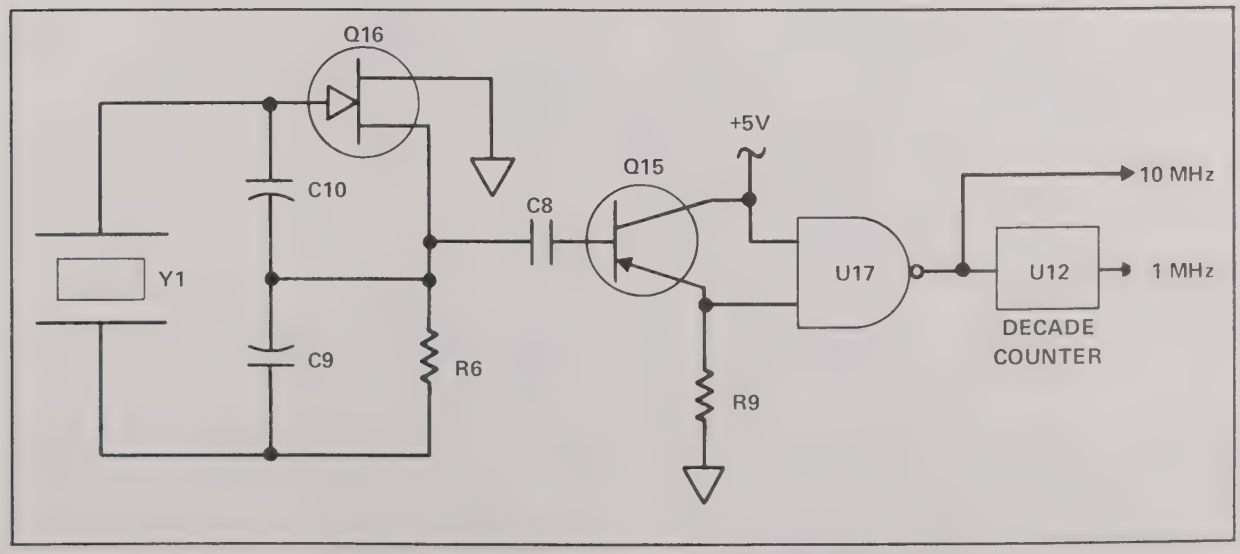

Figure 3-9. TIME BASE OSCILLATOR, BLOCK DIAGRAM

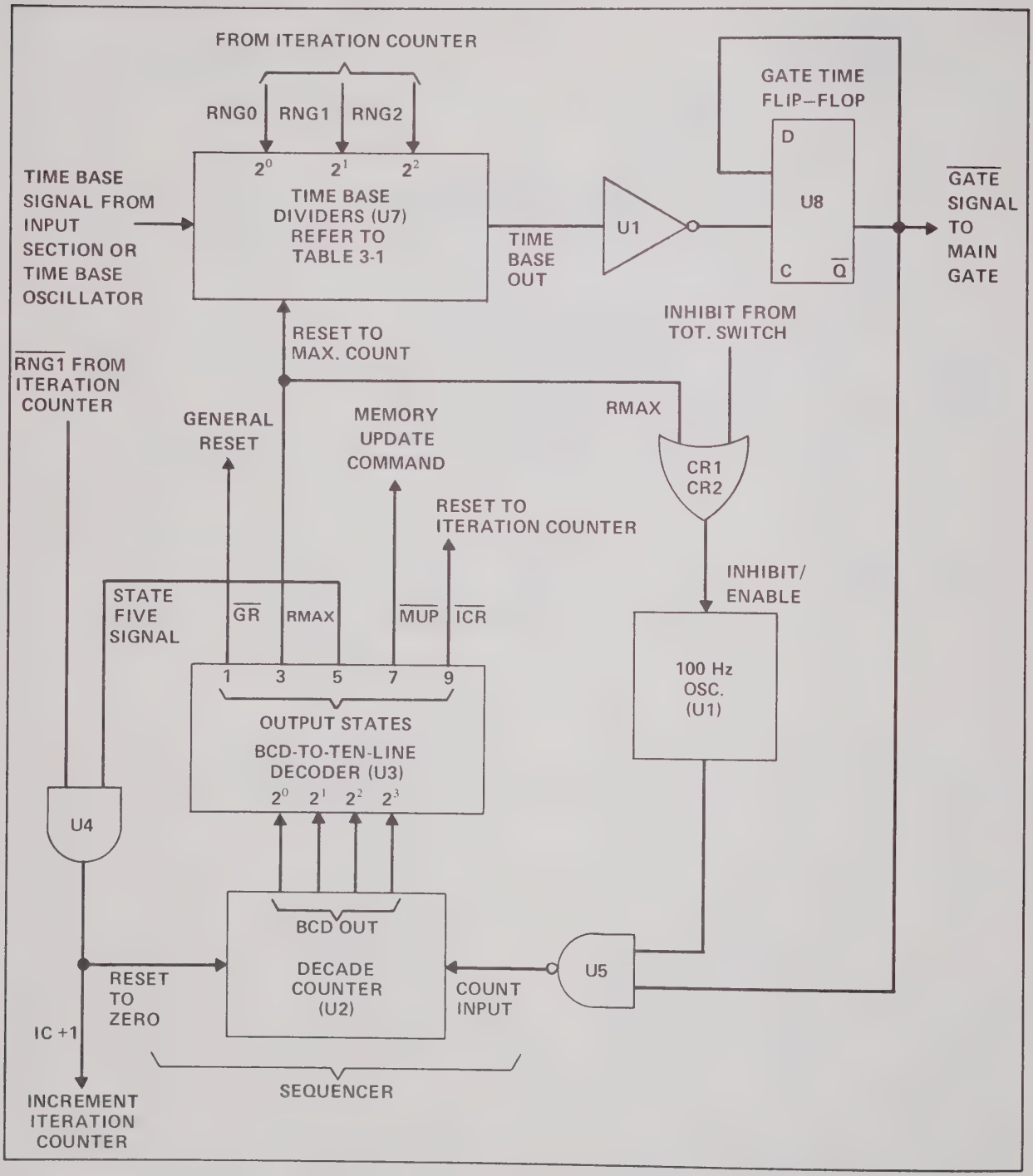

Figure 3-10. TIME BASE DIVIDERS/CONTROL LOGIC, BLOCK DIAGRAM

(U2) and a BCD-to-ten-line decoder (U3) are at count state one (i.e. the 2^0 output of the decade counter is true). State one is a general reset (GR) command which is used to reset the decade counters and the autorange logic. The counter advances to state two, and 10 milliseconds later, to state three.

3-49. For all states of the sequencer, except state three, the state three (RMAX) output is high to reset and hold the time base dividers at maximum count (i.e. 999·), and to enable the 100 Hz oscillator. When the sequencer reaches state three, the time base dividers are allowed to count and will wrap-around to zero upon receipt of the first pulse of

Table 3-1. TIME BASE DIVIDER RATIOS (U7)

RANGE CODE LINES TO U7			Division Factor Input/Output	Front-Panel Selected Resolution/ Periods Averaged
RNG2 (PIN 12)	RNG1 (PIN 13)	RNG0 (PIN 14)		
0	0	0	10^0	10^0
0	0	1	10^1	10^1
0	1	0	10^2	10^2
0	1	1	10^3	10^3
1	0	0	10^4	100Hz
1	0	1	10^5	10Hz
1	1	0	10^6	1Hz
1	1	1	10^7	0.1Hz

time base signal from the time base oscillator or input section (period mode). When the time base counters wrap-around to zero, a leading pulse edge appears at the time base output to set the gate time flip-flop (U8) and enable the main gate. During the time the main gate is enabled, gate U5 is inhibited and the 100 Hz oscillator output is prevented from advancing the sequencer past state three.

3-50. Also during this time, the time base dividers are being allowed to count the input pulses applied to their input. This action continues until the time base dividers reach full-count and then wrap-around to zero again. This action produces a second leading pulse edge at the time base output to toggle the main gate flip-flop (U8) back to the reset state to generate a positive-going pulse edge at its Q output. The positive-going edge inhibits the main gate and is also received at the count input of the sequencer (via gate U5) to advance the counter to the next state (state four). State four resets and holds the time base dividers at maximum count. Since the main gate flip-flop is now reset, Gate U5 is enabled and the 100 Hz pulses are again applied to the count input of the sequencer. Ten milliseconds after advancing to state four, the sequencer advances to state five.

3-51. State five of the sequencer performs functions only when counter operation is in the autorange mode, and only when the autorange logic is still achieving the optimum range. If the autorange logic is still achieving optimum range, a false RNG1 signal from the iteration counter within the autorange logic is present to enable gate U9. The state five output of the sequencer resets its decade counter to zero and issues a pulse (IC + 1 command) to increment the iteration counter within the autorange logic. From the zero state, the 100 Hz oscillator advances the counter to state three to generate the RMAX command and repeat the described sequence.

3-52. When state five of the sequencer is reached with no RNG1 signal from the autorange logic, the sequencer progress to state seven and generates a memory update (MUP) command to the display memory, the decimal point logic and the autorange logic. The MUP command causes the display to be updated to the last measurement. After state seven, state nine resets the iteration counter within the autorange logic back to zero. State one issues a general reset to the decade counters and autorange logic. State three issues the RMAX commands to initiate the next measurement sequence.

3-53. Auto Range Logic

3-54. The function of the autorange logic is to automatically select the highest operating range (longest gate time) without overflowing the display. If the gate time is shorter than necessary, then resolution is lost; and if the gate time is too long, then the most significant digit(s) may be lost due to overflow. The autorange logic automatically selects optimum range for a particular input before allowing the sequencer in the control logic to issue the memory update command. However, the autorange logic will not select the 10 second gate time since it may take the logic as many as three range changes to determine the optimum range, and 11 seconds is too long for the operator to wait for an up-to-date measurement.

3-55. The autorange logic also provides range control hysteresis. That is, the counter will uprange at a certain frequency count, but will not downrange until the frequency count falls well below the uprange point. For example, a frequency count of 999999 on the 1.0 second range is acceptable, but when increased by a single count causes the autorange logic to change to the 0.1 second range and display 100000. If a decrease of a single count (or even a few counts) was allowed to shift the range back to the 1.0 second gate time, then the autorange logic would be constantly upranging and downranging whenever an input signal (near the autorange shift point) had a small amount of frequency modulation or jitter. The result would be unstable display due to the shifting of decimal point and measurement data. To avoid this problem, the autorange logic upranges whenever the count exceeds 999999, and down ranges whenever the count drops to 079999. This hysteresis provides a 20% overlap of frequencies and prevents unnecessary upranging and downranging.

3-56. To follow the action of the autorange logic, refer to Figures 3-11 and 3-12. The autorange logic receives its commands from the sequencer within the control logic, and receives its display information (autorange sense input) from the 2^3 output of the 2SD decade counter, which is

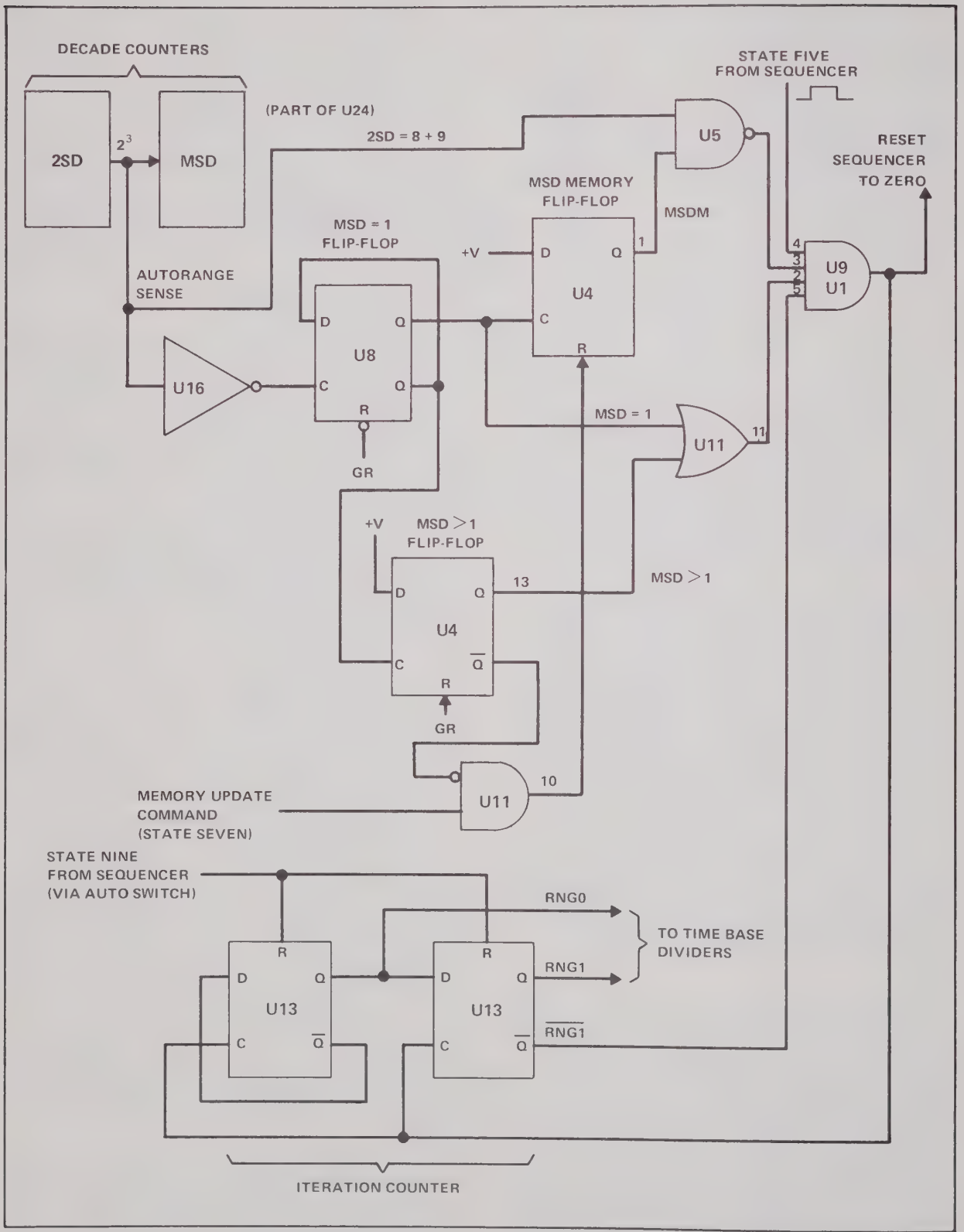

Figure 3-11. AUTORANGE LOGIC, BLOCK DIAGRAM

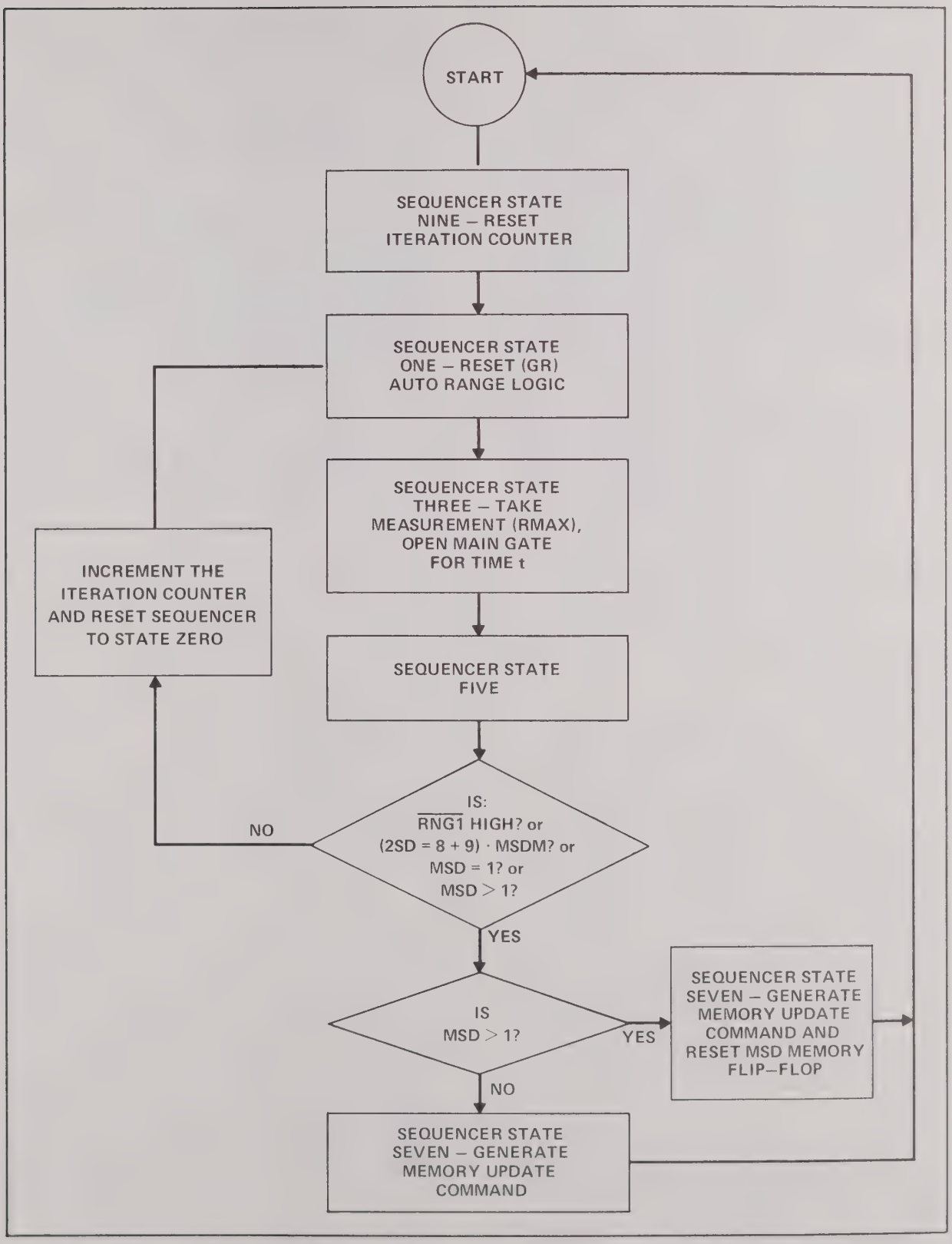
START
SEQUENCER STATE NINE – RESET ITERATION COUNTER
SEQUENCER STATE ONE – RESET (GR) AUTO RANGE LOGIC
SEQUENCER STATE THREE – TAKE MEASUREMENT (RMAX), OPEN MAIN GATE FOR TIME t
SEQUENCER STATE FIVE
IS: $\overline{RNG1}$ HIGH? or (2SD = 8 + 9) · MSDM? or MSD = 1? or MSD > 1?
NO
INCREMENT THE ITERATION COUNTER AND RESET SEQUENCER TO STATE ZERO
YES
IS MSD > 1?
YES
SEQUENCER STATE SEVEN – GENERATE MEMORY UPDATE COMMAND AND RESET MSD MEMORY FLIP–FLOP
NO
SEQUENCER STATE SEVEN – GENERATE MEMORY UPDATE COMMAND

Figure 3-12. AUTORANGE LOGIC FLOW CHART

also the carry line to the MSD decade counter. This line goes true whenever the 2SD decade counter achieves a count of eight, and goes false to provide a trailing edge whenever the 2SD exceeds a count of nine and increments the MSD decade counter to a count of one or greater.

3-57. Initially, the iteration counter (which controls the time base dividers, and consequently determines the operating range) is reset to zero by the state nine output of the sequencer. In the zero state, the RNG 0 and RNG1 outputs are false or low, and the iteration counter selects the 0.01 second range. When the sequencer advances to the one state, a general reset (GR) command is generated to reset the MSD=1 and MSD < 1 flip-flops shown in Figure 3-11.

3-58. When the sequencer reaches state three, the previously described measurement cycle begins to enable the main gate, load the decade counters, inhibit the main gate, etc. The sequencer then advances to state five. Depending upon conditions at the other three inputs of AND gate U9 (shown in Figure 3-11), the state five output of the sequence will be (1) used to reset the sequencer back to the zero state and increment the iteration counter, of (2) will be ignored so that the sequencer can proceed to state seven to generate the memory update command and load the previous measurement data from the decade counters into the display memory.

3-59. Assume that at the end of the gate time, the contents of the decade counters was 012345, where zero is the MSD. The sequencer advances to state five, and the state five signal is passed by the four-input AND gate (formed by U9 and U1). The gate is enabled since the $\overline{\text{RNG1}}$ signal went high when the iteration counter was previously reset; 2SD = 8 + 9 is low due to no 8 or 9 in the 2SD decade counter; and none of the flip-flops have gone set due to no trailing edges appearing on the autorange sense line. (Trailing edges appear on the autorange sense line only when the MSD decade counter is incremented). Since none of the conditions are met to inhibit gate U9, the five output increments the iteration counter and resets the sequencer to the zero state to begin the next iteration. With the iteration counter incremented to its next state, the next range (0.1 second) is automatically selected.

3-60. As a result of the same measurement on the 0.1 second range, the contents of the decade counters is now 12345x, where 1 is the MSD. Since there is now an MSD, there has been a trailing edge on the autorange sense line to set the MSD = 1 and MSD < 1 flip-flops. The output of the MSD = 1 flip-flop inhibits the AND gate (U9) and causes state five of the sequencer to be ignored. The sequencer then proceeds to state seven to generate the memory update command to update the display with the measurement taken on the 0.1 second range. The sequencer then progresses to state nine to reset the iteration counter and begin the entire autorange sequence over again starting with the lowest range (0.01 second).

3-61. If the frequency of the input signal is decreased, or the period is decreased, so that the contents of the decade counters become less than 100000 (i.e. they drop to some value between 099999 and 080000), the autorange logic will prevent a downrange shift until the counters drop to 079999 or below. For example, assume the counter's contents drop from 12345x to 099999. The MSD = 1 flip-flop remains reset as a result of the GR signal of sequencer state one; the MSD < 1 flip-flop remains set since the GR signal has no effect; the MSD > 1 flip-flop never got set; and the 2SD = 8 + 9 signal is high due to the 9 present in the 2SD decade counter. The high MSDM and 2SD = 8 + 9 signals inhibit the AND gate U9 and prevent the state five output of the sequencer from incrementing the iteration counter and resetting the sequencer to zero. Since the sequencer is not reset, it is allowed to progress to state seven to generate the memory update command, etc.

3-62. When the signal under measurement changes so that the decade counters contain 079999 or less at the end of the measurement, conditions within the autorange logic are the same as with 099999 in the decade counters, except for the 2SD = 8 + 9 line, which is now low due to a 7 (or less) in the 2SD decade counter. As a result, the AND gate U9 is enabled, and sequencer state five increments the iteration counter to produce the 1.0 second range,and the sequencer is reset to zero to repeat the measurement on the new range without updating the display at this time.

3-63. At the end of the 1.0 second measurement, the decade counters contain 79999x. At the time of state five, the MSD > 1 flip-flop is set to inhibit AND gate U9. ($\overline{\text{RNG1}}$ is also high to inhibit AND gate, but would not be if the contents of the decade counters had been ten times greater and the autoranging had ceased at the 0.1 second range.) With the AND gate inhibited, state five is ignored. State seven issues the memory update command to enter the new measurement into the display memory. The memory update command resets the MSD memory flip-flop due to the set state of the MSD < 1 flip-flop. The remainder of the autorange logic is reset by states nine and one of the sequencer.

3-64. The preceeding paragraphs describe the downranging action of the autorange logic when the input fre-

quency to the decade counters decreases from 12345x to 099999 to 799999, with the range change point being 080000/799999. Upranging action is similar, but takes place at the 999999/10000 point instead of the 799999/080000 point. When the signal under measurement changes so that the decade counters increase from 799999 to 800000, the autorange logic recognizes no change other than the 2SD = 8 + 9 line which is now low. However, U9 is still not enabled due to the setting of the MSD > 1 flip-flop due to the 8 in the MSD decade counter. As a result, state five is ignored and state seven issues the memory update command, etc. When the signal under measurement changes so that the contents of the decade counters increase from 999999 to 100000, the logic upranges to the next shortest gate time in order to avoid a display of 000000 plus overflow.

NOTE

It should be kept in mind that the autorange logic, by means of the iteration counter, always begins a measurement cycle with the shortest gate time, and steps up (never down) to the optimum gate time.

3-65. Manual Range Control

3-66. When the counter is not in the autorange mode, it is in the manual range control mode. Manual selection of the different ranges is achieved by using the front-panel RESOLUTION/PER AVGD switches to override the resetting and incrementing action of the iteration counter, which in turn programs the time base dividers in accordance with its particular state. The front-panel switches force the iteration counter to one of its four states and hold it there until either another RESOLUTION/PER AVGD switch is closed, or the autorange function is selected. During manual range control mode, the autorange logic is inhibited by the MSD > 1 flip-flop, which is held in its set state by the selection of the front-panel RESOLUTION/PER AVGD switches. (Refer to the schematic diagram, 1900A–1001 sheet 2 of 3.)

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains information concerning preventive and corrective maintenance for the Model 1900A Multi-Counter. A maintenance interval of one year for calibration is recommended to ensure instrument operation within the one year specifications. Equipment for performing maintenance tests and adjustments is listed in Table 4-1. If this equipment is not available, other equipment having equivalent specifications may be used.

NOTE

When greater than one year accuracy is required, refer to specifications for timebase aging rate to determine the re-calibration interval required to maintain desired accuracy.

4-3. SERVICE INFORMATION

4-4. Should your instrument need repair, send it to the nearest factory authorized service center. A list of these authorized service centers is located on the inside of the front cover. Also located on the inside front cover is the WARRANTY which warrants the instrument for a period of one year.

4-5. GENERAL MAINTENANCE

4-6. Access

4-7. Use the following procedure to gain access to the interior of the Model 1900A.

a. With the power switch OFF, disconnect the line cord.

b. Remove the Phillips screw at the rear of the instrument case.

c. Remove the instrument from the case.

4-8. Cleaning

4-9. Clean the front panel and case with denatured alcohol or mild solution of detergent and water. Do not use aromatic hydrocarbons or chlorinated solvents because they will react with the plastic materials of the instrument.

4-10. Fuse Replacement

4-11. The input power fuse, F1, is located within the instrument in a fuse clip near the power transformer (T1). To gain access to the fuse, refer to paragraph 4-6. When replacement is required, install AGC 1/8A (fast acting) for line powered instruments. Use MDA ½A (slow blow) for battery powered instruments.

4-12. PERFORMANCE CHECKS

4-13. The performance checks provide a means of verifying overall operation of the Model 1900A. The checks can be used as an acceptance check during incoming inspection or as a periodic maintenance check. Refer to Table 4-1 for a list of required test equipment. Equivalent equipment may be used.

4-14. Functional Check

4-15. To perform a functional check of the Model 1900A, refer to the self-check described in Section 3.

4-16. Sensitivity Check

4-17. Perform the sensitivity checks as follows:

Table 4-1. TEST EQUIPMENT REQUIRED FOR PERFORMANCE TEST, CALIBRATION AND TROUBLESHOOTING

EQUIPMENT NOMENCLATURE	RECOMMENDED MODEL	WHERE USED
Quartz Oscillator Frequency Standard with 10 MHz Output		Timebase Oscillator Adjustment
Low-Frequency Oscillator	HP204D	
High-Frequency Oscillator	HP8654A	
RF millivoltmeter with 50Ω terminator	Boonton 91C	Sensitivity Check
Multimeter	Fluke 8000A	Troubleshooting
Oscilloscope	Tek 465	Troubleshooting

a. Connect the low frequency generator, set for 5 Hz at 25mV, to the 1900A input.

b. Energize the counter and depress the FREQ function switch and AUTO resolution switch.

c. Confirm that the counter display indicates .005 kHz ± 1 digit.

d. Disconnect the low frequency generator from the input.

e. Connect the high frequency generator, terminated into 50 ohms, to a T-connector on the 1900A input. Set the generator output for 10 MHz at approximately 25mV rms.

g. Connect the RF millivolt meter to the T-connector on the input of the 1900A.

h. Adjust the high frequency generator output for a reading of exactly 25mV on the RF millivolt meter.

i. Confirm that the counter display indicates 10.0000 MHz ± generator accuracy.

j. Change the generator output to 80 MHz at exactly 25mV.

k. Confirm that the counter display indicates 80.0000 MHz ± generator accuracy.

4-18. CALIBRATION

4-19. Calibration of the Model 1900A is limited to adjustment of the trigger level and time base oscillator frequency.

4-20. Trigger Level Adjustment

4-21. Trigger level adjustment should be performed whenever repairs have been made to the input section of the counter. The input section comprises that circuitry contained on the input printed circuit board assembly. Perform trigger level adjustment as follows:

a. Remove the counter from the case (paragraph 4-6)

b. Energize the counter and connect the high-frequency oscillator to the counter input.

c. Select an output of 25 mV rms at approximately 80 MHz on the oscillator.

d. Adjust the trigger level control (R14) to a mid-point which produces a stable display near 80 MHz.

e. Reduce the signal level until the display becomes unstable.

f. Re-adjust the trigger level control until the display is again stable.

g. Repeat steps e and f until no additional sensitivity increase is possible.

4-22. Time-Base Oscillator Adjustment

4-23. Time base oscillator adjustment should be made whenever the oscillator is repaired, or whenever it is determined that accuracy of the counter is not within the accuracy desired. Perform time base oscillator adjustment in an environment having an ambient temperature of +22°C to +25°C (72°F to 77°F).

4-24. TIME BASE ADJUSTMENT USING A FREQUENCY STANDARD

a. Remove the counter from the case (paragraph 4-6)

b. Energize the counter and select the FREQ function and 10 Hz resolution.

c. Select a 10 MHz output on the quartz oscillator and connect the 10 MHz signal to the counter input.

d. While observing the counter display, adjust the time base oscillator control (C11 located on the main pcb directly behind the reset switch) to obtain a reading of 000000 ± 1 digit.

4-25. TROUBLESHOOTING

4-26. The following information is designed to aid in troubleshooting the Model 1900A. Fault isolation is achieved by executing the self-check described in Section 2 and noting failure symptoms. Figures 4-2 through 4-6 list several failure sumptoms and their possible causes. Use these figures as troubleshooting guides in conjunction with the theory of operation presented in Section 3. Use Figure 4-1 to locate the test points on the main printed circuit board assembly.

4-27. REPAIR TECHNIQUES

4-28. Battery-Powered Instruments

4-29. In battery-powered instruments, one of the batteries should be removed before attempting any repair. This is necessary to eliminate the danger of shorting portions of the circuitry which carry the battery voltage. Remove the battery as described in Section 6.

4-30. Integrated Circuit Replacement

4-31. Three types of integrated circuits are used in the Model 1900A, as listed in Table 4-2, and the handling of TTL types require no special handling. However, the

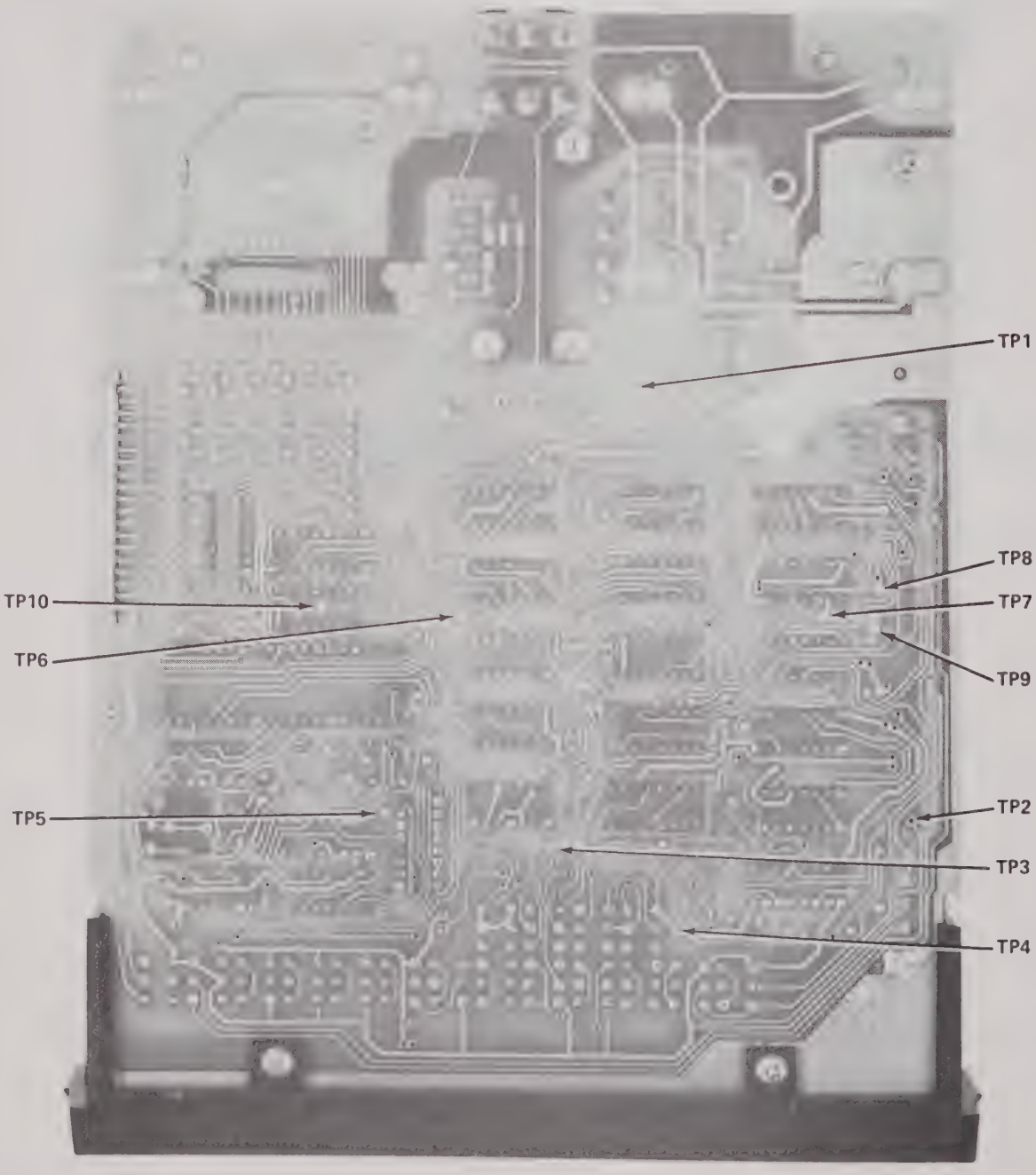

Figure 4-1. TEST POINT LOCATIONS

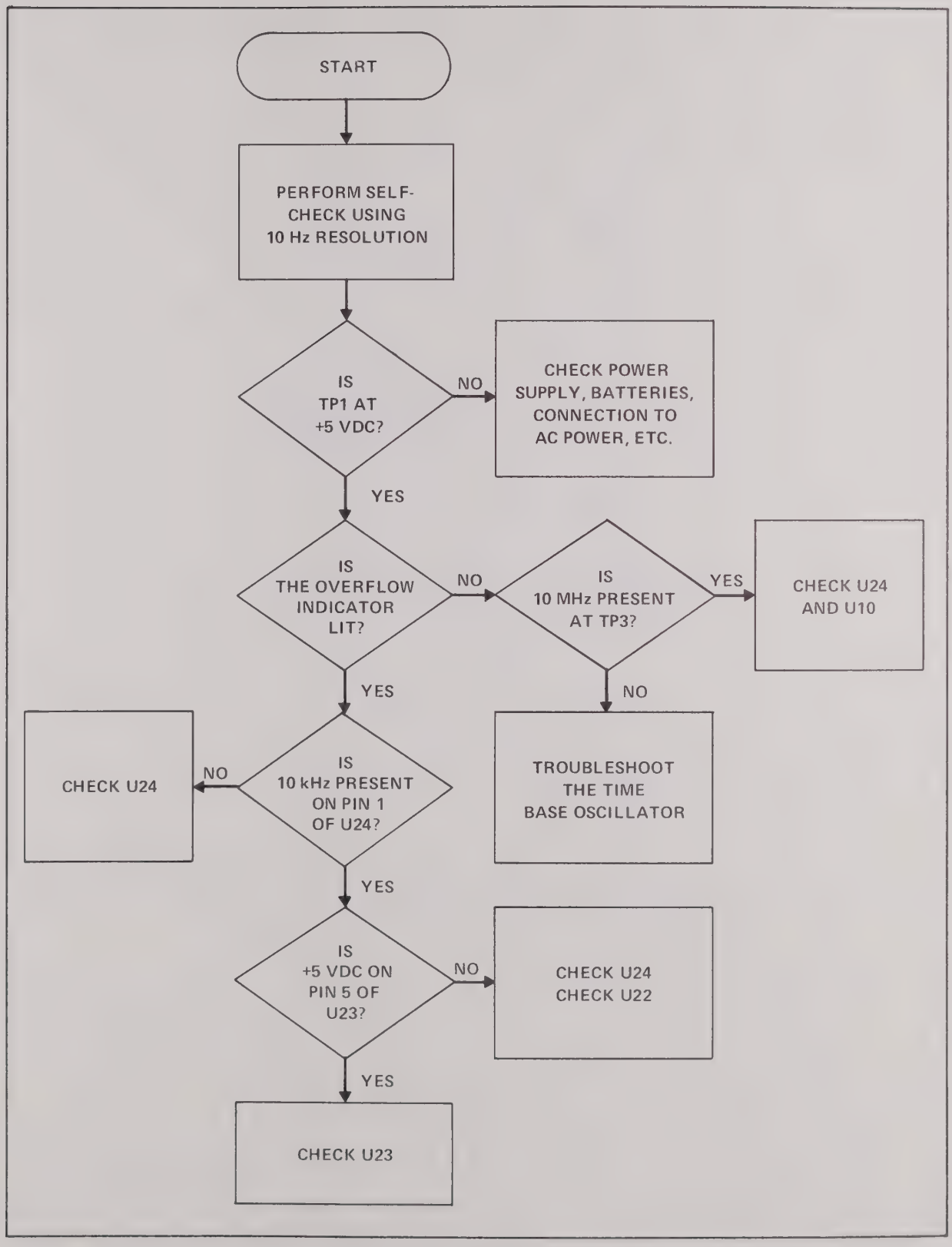

Figure 4-2. FAULT ISOLATION – NO DISPLAY

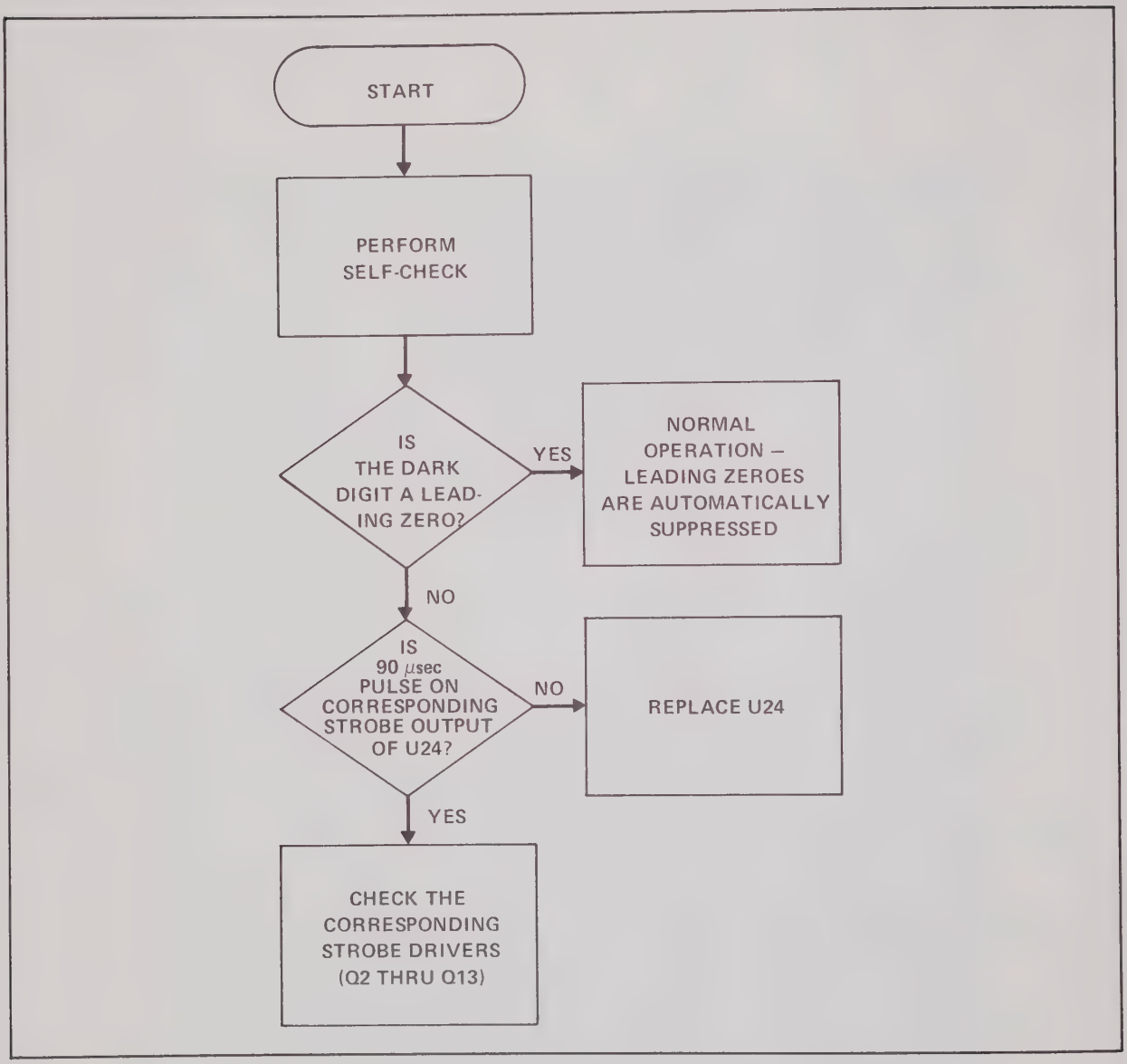

Figure 4-3. FAULT ISOLATION – ONE DARK DIGIT

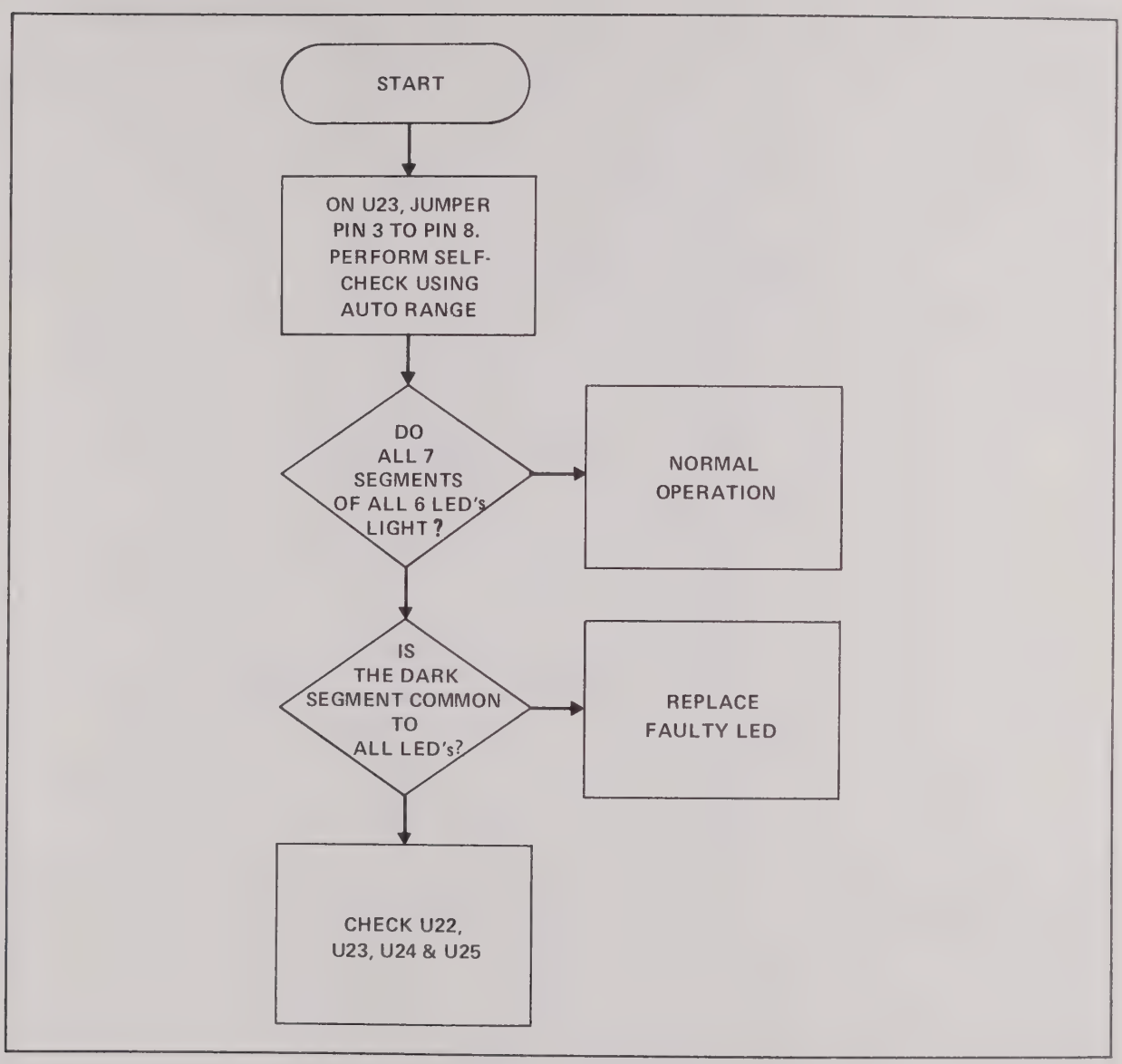
START
ON U23, JUMPER PIN 3 TO PIN 8. PERFORM SELF-CHECK USING AUTO RANGE
DO ALL 7 SEGMENTS OF ALL 6 LED's LIGHT ?
NORMAL OPERATION
IS THE DARK SEGMENT COMMON TO ALL LED's?
REPLACE FAULTY LED
CHECK U22, U23, U24 & U25

Figure 4-4. FAULT ISOLATION – DARK LED SEGMENT

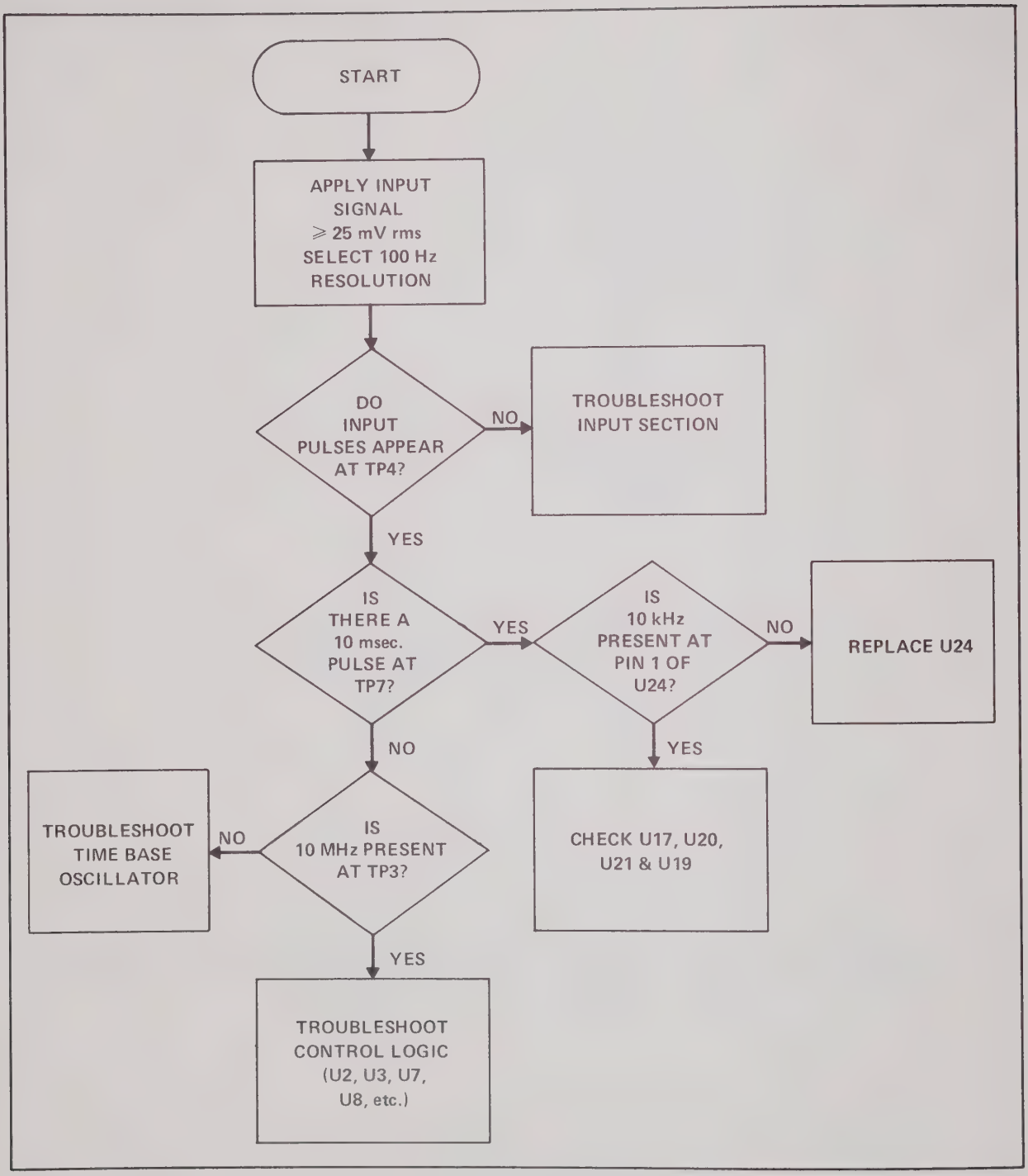

Figure 4-5. FAULT ISOLATION – NO COUNTING ACTION

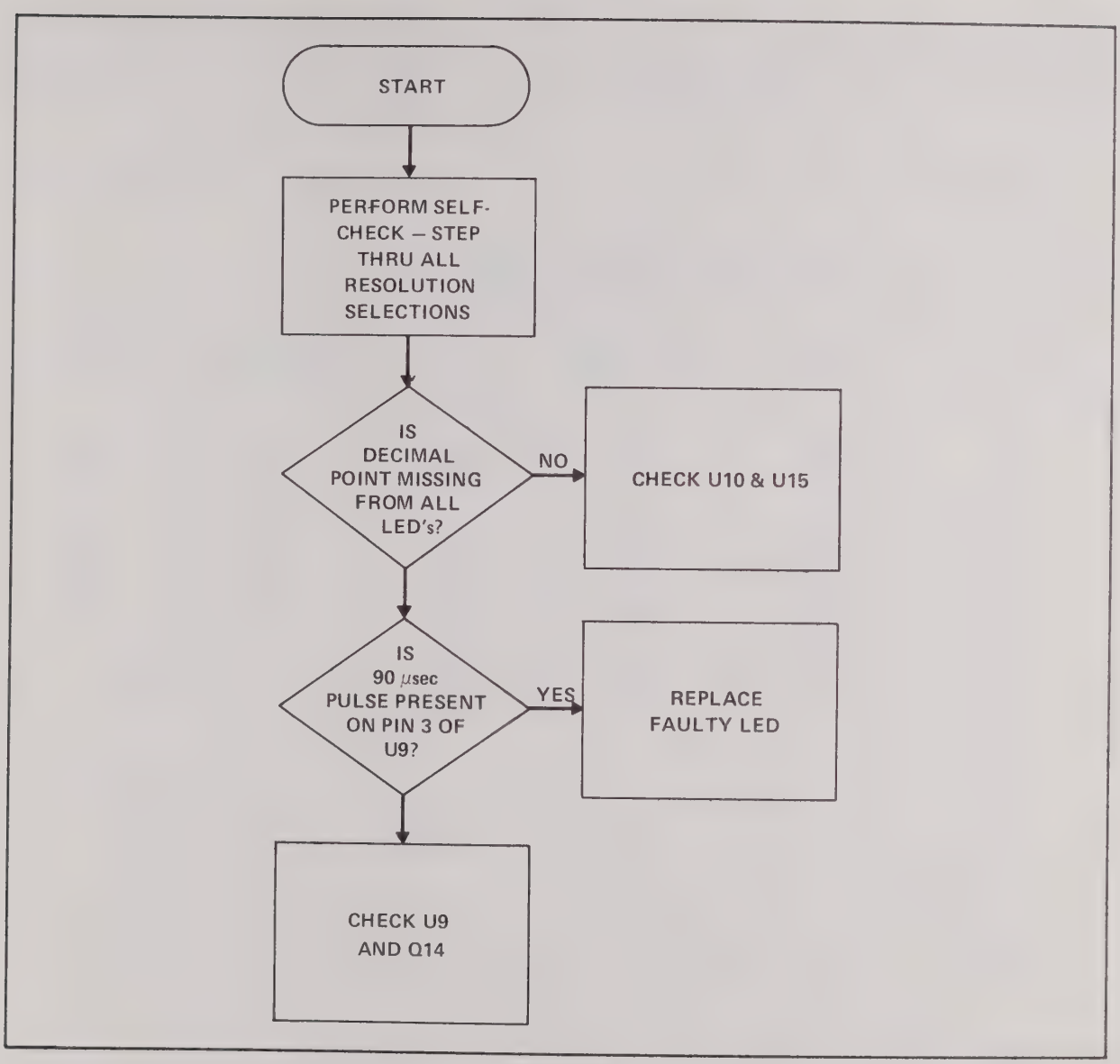
START
PERFORM SELF-CHECK – STEP THRU ALL RESOLUTION SELECTIONS
IS DECIMAL POINT MISSING FROM ALL LED's?
NO
CHECK U10 & U15
IS 90 μsec PULSE PRESENT ON PIN 3 OF U9?
YES
REPLACE FAULTY LED
CHECK U9 AND Q14

Figure 4-6. FAULT ISOLATION – DECIMAL POINT MISSING

CMOS and PMOS types can be destroyed by a static electricity discharge. To prevent damage due to static discharge, the following precautions should be taken whenever this type of integrated circuit is handled:

a. The PMOS or CMOS integrated circuit is packed in conductive foam. Do not remove the conductive foam from the integrated circuit until ready for installation into the unit.

b. Be sure the repairing personnel and the unit under repair are commonly grounded.

c. Be sure the soldering iron used is grounded to the common ground.

Table 4-2. MODEL 1900A INTEGRATED CIRCUIT TYPES.

REFERENCE DESIGNATOR	TYPE	REFERENCE DESIGNATOR	TYPE	REFERENCE DESIGNATOR	TYPE
U1	CMOS	U10	CMOS	U19	TTL
U2	TTL	U11	CMOS	U20	TTL
U3	TTL	U12	TTL	U21	TTL
U4	CMOS	U13	CMOS	U22	CMOS
U5	CMOS	U14	CMOS	U23	TTL
U6	CMOS	U15	CMOS	U24	PMOS
U7	PMOS	U16	CMOS	U25	R
U8	TTL	U17	TTL		
U9	CMOS	U18	CMOS		

Section 5

Lists of Replaceable Parts

TABLE OF CONTENTS

ASSEMBLY NOMENCLATURE	PART NO.	PAGE
Final Assembly	1900A	5-3
Main PCB Assembly, Line Configuration	385021	5-5
Main PCB Assembly, Battery Configuration	378083	5-5
Input PCB Assembly	378125	5-11
Display PCB Assembly	378109	5-14
Inverter PCB Assembly	388447	5-15

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Electrical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers. (See Appendix A for Code-to-Name list.)

e. Manufacturer's Part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommending number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity, paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure the prompt and efficient handling of your order, include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation or Item Number.

e. Printed Circuit Board Part Number.

f. Instrument Model and Serial number.

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY

FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY **Figure 5-1.**	1900A	89536				
	Main PCB Assembly, Line Configuration (See Figure 5-2) (115V)	384875	89536	384875	1		
	(100V)	395129	89536	395129	1		
	Main PCB Assembly Battery Configuration (See Figure 5-3)	385021	89536	395021	1		
	Input PCB Assembly (See Figure 5-4)	378406	89536	378406	1		
	Display PCB Assembly (See Figure 5-5)	378398	89536	378398	1		
	Inverter PCB Assembly (See Figure 5-6)	388454	89536	388454	1		
	Case, molded plastic	330076	89536	330076	1		
	Decal, front panel	381434	89536	381434	1		
	Decal, knob	347401	89536	347401	2		
	Handle, molded	330092	89536	330092	1		
	Lens, red plastic	384701	89536	384701	1		
	Line Cord	343723	89536	343723	1		
	Pad, foot	338632	89536	338632	2		
	Panel, front molded	378067	89536	378067	1		

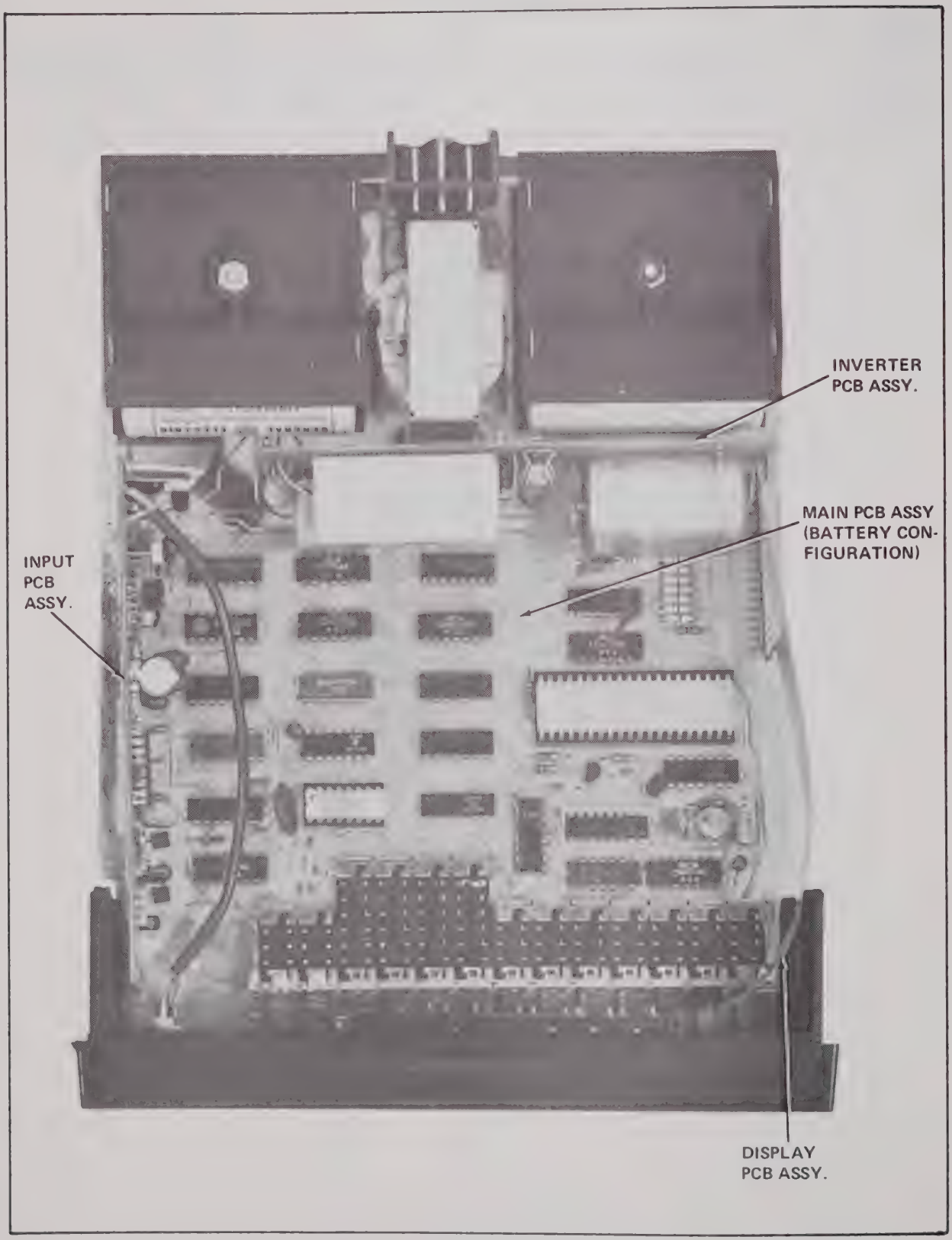

Figure 5-1. FINAL ASSEMBLY

MAIN PCB ASSEMBLY LINE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MAIN PCB ASSEMBLY LINE (115V) 1 **Figure 5-2**	378414	89536	378414	REF		
	(100V) 1	395129	89536	395129	REF		
	MAIN PCB ASSEMBLY BATTERY 2 **Figure 5-3**	385021	89536	385021	REF		
BT1	Battery, Ni cad 2	346924	17338	41B004AD15G L	4		
BT2	Battery, Ni cad 2	346924	17338	41B004AD15G L	REF		
BT3	Battery, Ni cad 2	346924	17338	41B004AD15G L	REF		
BT4	Battery, Ni cad 2	346924	17338	41B004AD15G L	REF		
C1	Cap, fxd cer, 0.01uf +80/–20%, 25V	335786	32897	5835·000Y5U 103Z	3		
C2	Cap, fxd cer, 0.01uf +80/–20%, 25V	335786	32897	5835·000Y5U 103Z	REF		
C3	Cap, fxd cer, 0.1uf ± GMV, 10V	368647	71590	UK 10-104	1		
C4	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015 JA1	3		
C5	Cap, Ta, 22uf ± 20%, 20V 2	357780	56289	196D226X0020 LA3	1		
C7	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015 JA1	REF		
C8	Cap, fxd cer, 0.001uf ±10%, 500V	357806	71590	CF102	2		
C9	Cap, fxd cer, 47pf ±20%, 100V	369132	56289	C030B102H470 5	REF		
C10	Cap, fxd cer, 22pf ±20%, 500V	369157	32897	831-000C0G022 0	1		
C11	Cap, var, 22pf	369207	80031	C010KA20E	1		
C12	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015 JA1	REF		
C13	Cap, fxd cer, 10pf ±10%, 3kV/4.5kV	105536	56289	40C362A1	1		
C14	Cap, Ta, elect, 22pf ±20%, 20V 1	357780	56289	196D226X0020 LA3	1		

MAIN PCB ASSEMBLY LINE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C15	Cap, elect, 5000pf ±10%, 10V ▷1	340893	99392	60C10BA553	1		
C16	Cap, elect, 470uf +50/−10%, 25V ▷1	168153	25403	ET471X025A01	1		
C17	Cap, fxd cer, 0.01uf +80/−20%, 25V	335786	32897	5835-000Y5U 103Z	REF		
C19	Cap, cer, disc, 100 pF, 10%, 1kV	105593	71590	DD101	1		
CR1	Diode, switching	364224	07263	1N914	4		
CR2	Diode, switching	364224	07263	1N914	REF		
CR3	Diode, zener, uncomp	203547	07910	1N7591A	1		
CR4	Diode, Si, rect ▷2	343491	*11711	1N4002	6		
CR5	Diode, Si, rect ▷2	343491	*11711	1N4002	REF		
CR6	Diode, Si, rect ▷1	343491	*11711	1N4002	REF		
CR7	Diode, Si, rect ▷1	343491	*11711	1N4002	REF		
CR8	Diode, Si, rect ▷1	343491	*11711	1N4002	REF		
CR9	Diode, Si, rect ▷1	343491	*11711	1N4002	REF		
CR10	Diode, Switching	364224	07263	1N914	REF		
CR11	Diode, switching	364224	07263	1N914	REF		
F1	Fuse, 1/8 amp, 250V ▷1	196970	71400	AGC	1		
Q1	Xstr, Si, PNP	381780	01295	TCS103	7		
Q2	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q3	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q4	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q5	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q6	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q7	Xstr, Si, PNP	381780	01295	TCS103	REF		
Q8	Xstr, Si, NPN	218396	04713	2N3904	7		
Q9	Xstr, Si, NPN	218396	04713	2N3904	REF		
Q10	Xstr, Si, NPN	218396	04713	2N3904	REF		
Q11	Xstr, Si, NPN	218396	04713	2N3904	REF		
Q12	Xstr, Si, NPN	218396	04713	2N3904	REF		
Q13	Xstr, Si, NPN	218396	04713	2N3904	REF		
Q14	Xstr, Si, NPN, Darlinton Amp	381798	04713	MPSA13	1		
Q15	Xstr, Si, NPN ▷1	218396	04713	2N3904	REF		

MAIN PCB ASSEMBLY LINE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q16	Xstr, FET [1]	386094		SX3819	1		
R1	Res, comp , 5.6k ±5%, ¼W	148080	01121	CB5625	1		
R2	Res, comp, 470k ±5%, ¼W	108290	01121	CB4741	2		
R3	Res, comp, 680Ω ±5%, ¼W	148007	01121	CB6815	1		
R4	Res, comp, 470k ±5%, ¼W	108290	01121	CB4741	REF		
R5	Res, comp, 470Ω ±5%, ¼W	147983	01121	CB4715	3		
R6	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	1		
R7	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	2		
R8	Res, comp, 56Ω± 5%, ¼W	147900	01121	CB5605	1		
R9	Res, comp, 470Ω ±5%, ¼W	147983	01121	CB4715	REF		
R10	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	1		
R11	Res, comp, 47k ±5%, ¼W	148163	01121	CB4735	1		
R12	Res, comp, 100Ω ±5%, ¼W	147926	01121	CB1015	1		
R13	Res, comp, 100k ±5%, ¼W	148149	01121	CB1045	1		
R14	Res, comp, 120 ±5%, ¼W	170712	01121	CB1215	1		
R15	Res, comp, 10k, ±5%, ¼W	148106	01121	CB1035	REF		
S1 thru S13	Switch Assembly	386078	89536	386078	1		
T1	Xfmr [1]	387704	89536	387704	1		
T1	Xfmr [2]	1900A-6511	89536	1900A-6511	1		
U1	IC, C-MOS, Hex Buffer/Inverter	381848	13327	CD4049AE	3		
U2	IC, TTL, MSI, Decade counter	293159	04713	MC7490P	3		
U3	IC, TTL, BCD to DEC DCOR	293142	04713	MC7442P	1		
U4	IC, C-MOS, Dual type D flip-flop	340117	04713	MC14013CL	3		
U5	IC, C-MOS, NAND Gates	355198	04713	MC14011CP	2		
U6	IC, C-MOS, Hex Buffer/Inverter	381848	13327	CD4049AE	REF		
U7	IC, P-MOS, Programmable Divider	381822		MK5009	1		
U8	IC, TTL, Dual, type D, trig flip-flop	310227	01295	SN7474N	1		
U9	IC, C-MOS, Dual, 4-input, Pos NAND Gate	355206	04713	MC14012CP	1		

MAIN PCB ASSEMBLY LINE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U10	IC, C-MOS Triple 3-input Pos NAND Gate	375147	95303	CD4023AE	2		
U11	IC, C-MOS, Quad input, Pos NOR Gates	355172	04713	MC14001CL	1		
U12	IC, TTL, MSI, Decade counter	293159	04713	MC7490P	REF		
U13	IC, TTL, BCD to DEC DCDR	340117	04713	MC14013CL	REF		
U14	IC, TTL, BCD to DEC DCDR	340117	04713	MC14013CL	REF		
U15	IC, C-MOS, Triple 3-input Pos NAND Gate	325147	95303	CD4023AE	REF		
U16	IC, C-MOS, Hex Buffer/Inverter	381848	95303	CD4049AE	REF		
U17	IC, TTL, Quad, 2-input POS NAND Gate	293068	04713	MC74H00P	1		
U18	IC, C-MOS, NAND Gates	355198	04713	MC14011CP	REF		
U19	IC, TTL, MSI, Decade counter	293159	04713	MC7490P	REF		
U20	IC, TTL, (Shottky) Dual J-K edge, trig flip-flop	363440	01295	SN745112N	2		
U21	IC, TTL, (Shottky) Dual J-K edge, trig flip-flop	363440	01295	SN745112N	REF		
U22	IC, C-MOS Hex Buffer	381830	95303	CD4050AE	1		
U23	IC, TTL, BCD to 7 segment Decoder Driver	385872	01295	7447AN	1		
U24	IC, Digital MOS, LSI	380238	89536	380238	1		
U25	IC, 8 Res network, 110 ohm, 5%, ¼W	386938			1		
U26	IC, Voltage Regulator <1>	381814	07263	78M05UC	1		
Y1	Crystal, 10 MHz	385732	89536	385732	1		

NOTE!

Flag note <1> denotes parts used on Main PCB Assembly Line configuration only.

Flag note <2> denotes parts used on Main PCB Assembly Battery configuration only.

* 08466 is vendor code for General Instruments of Canada.

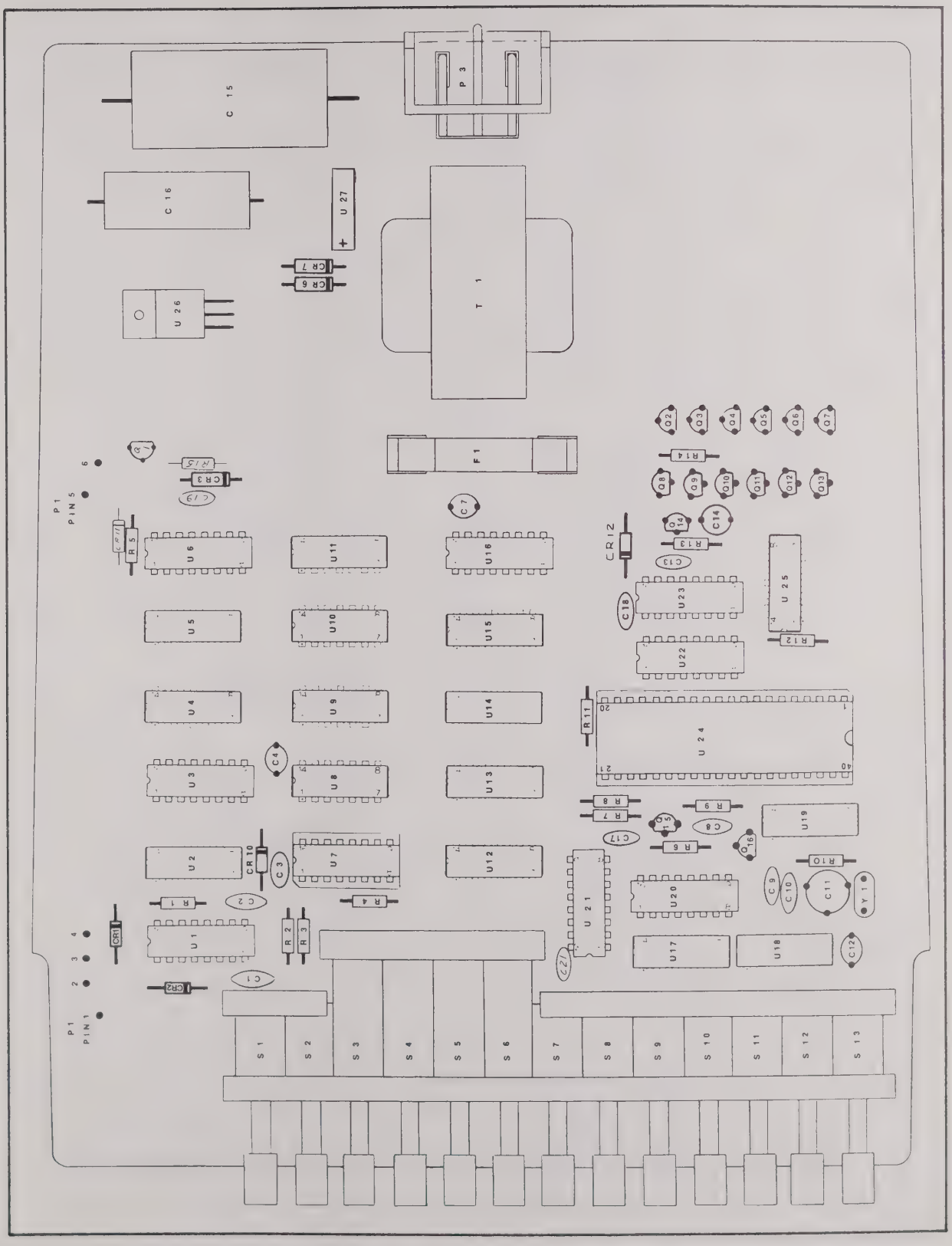

Figure 5-2. MAIN PCB ASSEMBLY – LINE CONFIGURATION

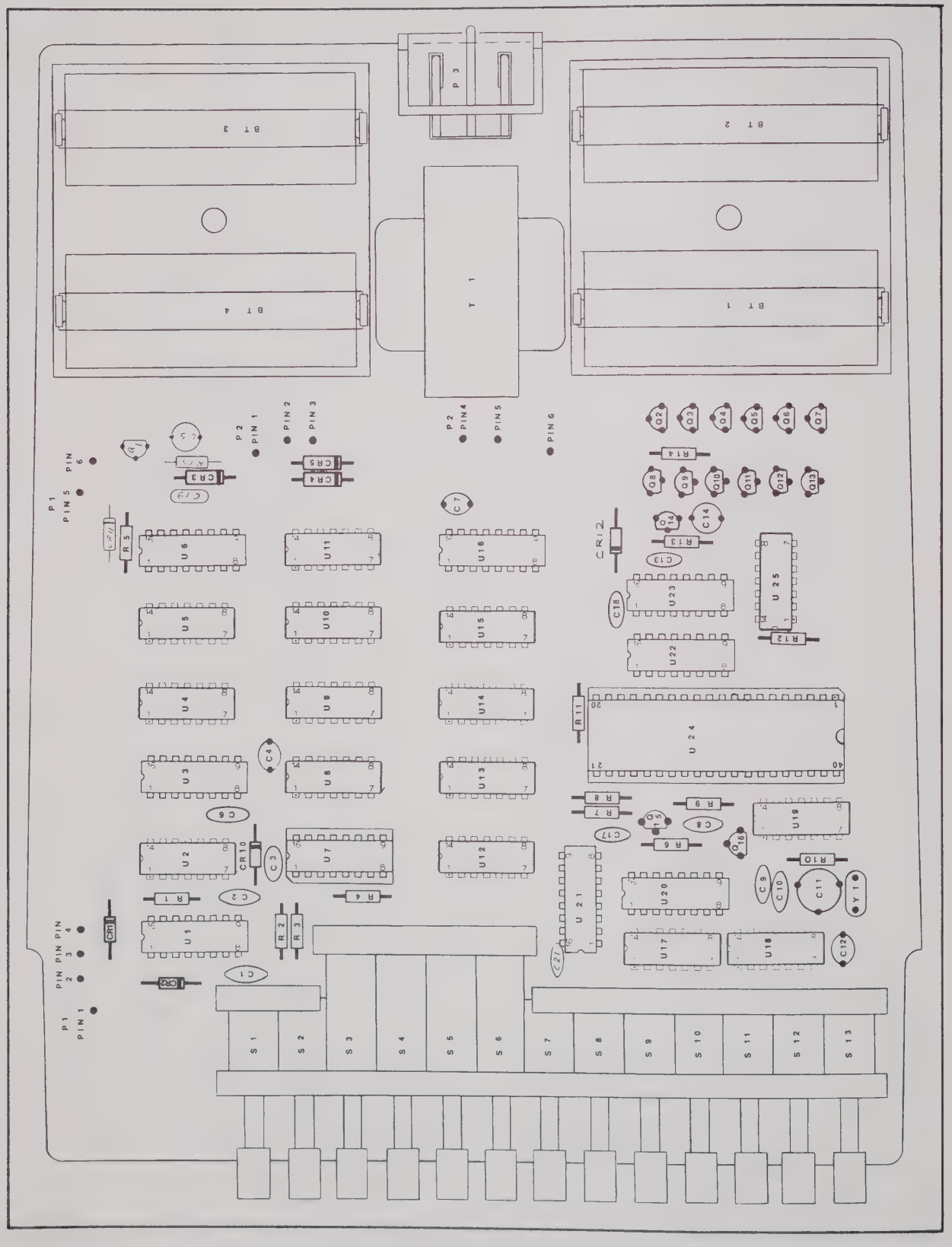

Figure 5-3. MAIN PCB ASSEMBLY – BATTERY (–01 OPTION) CONFIGURATION

INPUT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	INPUT PCB ASSEMBLY **Figure 5-4**	378406	89536	378406	REF		
	Input PCB 1900A-3003	378117	89536	378117			
C1	Cap, fxd cer, 0.1uf +80/–20%, 500V	161992			1		
C2	Cap, fxd cer, 100pf ±10%, 1kV	105593	71590	DD-101	1		
C3	Cap, fxd cer, 0.01uf +80/–20%, 25V	335786	32897	5835-000Y5U 103Z	4		
C4	Cap, elect, 22uf ±20%, 20V	357780	56289	196D226X0020 LA3	2		
C5	Cap, elect, 22uf ±20%, 20V	357780	56289	196D226X0020 LA3	REF		
C6	Cap, fxd cer, 0.002 uf ±10%, 500V	357806	71590	CF-102	1		
C7	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015 JA1	2		
C8	Cap, fxd cer, 0.01uf +80/–20%, 25V	335786	32897	5835-000Y5U 103Z	REF		
C9	Cap, mini cer, 4.7 pF, 100V, 20%	362772			1		
C10	Cap, fxd cer, 47pf ±20%, 1000V	369132	56289	C030B102H470 J	1		
C11	Cap, fxd cer, 0.01uf +80/–20%, 25V	335786	32897	5835-000Y5U 103Z	REF		
C12	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015 JA1	REF		
C13	Cap, fxd cer, 0.01uf +80/–20%, 500V	335786	32897	5835-000YU5 103Z	REF		
CR1	Diode, Ultra fast, Lo Cap, Si	381806	07263	1N3062	4		
CR2	Diode, Ultra fast, Lo Cap, Si	381806	07263	1N3062	REF		
CR3	Diode, Ultra fast, Lo Cap, Si	381806	07263	1N3062	REF		
CR4	Diode, Ultra fast, Lo Cap, Si	381806	07263	1N3062	REF		
CR5	Diode, Switching	364224	07263	1N914	4		
CR6	Diode, Switching	364224	07263	1N914	REF		
CR7	Diode, Switching	364224	07263	1N915	REF		
CR8	Diode, Switching	364224	07263	1N914	REF		
CR9	Diode	385385	07263	1N756A	1		

INPUT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q1	Xstr	369611	07263	2N5245	1		
Q2	Xstr, PNP, High speed switch	369629	07263	2N5771	5		
Q3	Xstr, PNP, High speed switch	369629	07263	2N5771	REF		
Q4	Xstr, NPN, Si, Lo P	369645	07263	2N4274	1		
Q5	Xstr, PNP, High speed switch	369639	07263	2N5771	REF		
Q6	Xstr, PNP, High speed switch	369629	07263	2N5771	REF		
Q7	Xstr, PNP, High speed switch	369629	07263	2N5771	REF		
R1	Res, comp, 180Ω ±5%, ¼W	147942	01121	CB1815	1		
R2	Res, comp, 180Ω ±5%, ¼W	147942	01121	CB1815	2		
R3	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	1		
R4	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	9		
R5	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R6	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	2		
R7	Res, comp, 100Ω ±5%, ¼W	147926	01121	CB1015	1		
R8	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	1		
R9	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	4		
R10	Res, comp, 330Ω ±5%, ¼W	147967	01121	CB3315	1		
R11	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	REF		
R12	Res, comp, 10Ω ±5%, ¼W	147868	01121	CB1005	1		
R13	Res, comp, 82Ω ±5%, ¼W	149484	01121	CB8205	1		
R14	Res, Trimpot, 10k	385393	Piher	PT10h10K	1		
R15	Res, comp, 47k ±5%, ¼W	148163	01121	CB4735	1		
R16	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	REF		
R17	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	REF		
R18	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R19	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R20	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R21	Res, comp, 680Ω ±5%, ¼W	148007	01121	CB6815	1		
R22	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		

INPUT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R23	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R24	Res, comp, 180Ω ±5%, ¼W	147942	01121	CB1815	REF		
R25	Res, comp, 270Ω ±5%, ¼W	160804	01121	CB2715	1		
R26	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R27	Res, comp, 560Ω ±5%, ¼W	147991	01121	CB5615	REF		
R28	Res, comp, 33Ω ±5%, ¼W	175034	01121	CB3305	1		
R29	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	REF		
R30	Res, comp, 150Ω ±5%, ¼W	147934	01121	CB1515	1		
R31	Res, comp, 220Ω ±5%, ¼W	147959	01121	CB2215	1		
U1	IC, ECL, Tripple line recv, OR/NOR	369702	04713	MC10116L	1		
	Connector, Test Jack	149112			2		
	Amp Connector	267492	00779	85863-2	4		

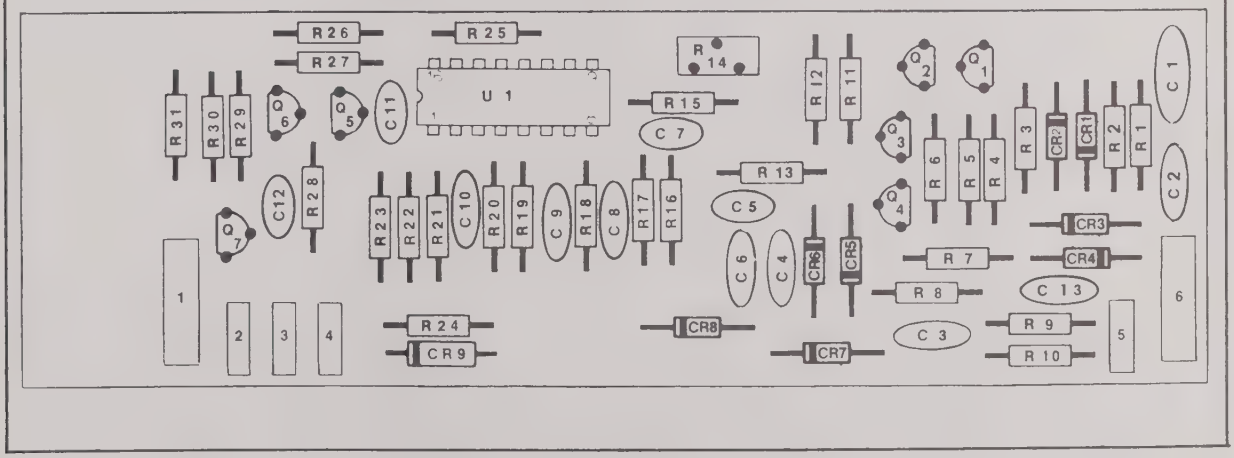

Figure 5-4. INPUT PCB ASSEMBLY

DISPLAY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DISPLAY PCB ASSEMBLY **Figure 5-5**	378387	89536	378398	REF		
DS201	Diode light emitting	385898	28480	5082–4487	3		
DS202	Diode light emitting	385898	28480	5082–4487	REF		
DS203	Diode light emitting	385898	28480	5082–4487	REF		
U201	Led, Display	380436	50579	DL-707-811	6		
U202	Led, Display	380436	50579	DL-707-811	REF		
U203	Led, Display	380436	50579	DL-707-811	REF		
U204	Led, Display	380436	50579	DL-707-811	REF		
U205	Led, Display	380436	50579	DL-707-811	REF		
U206	Led, Display	380436	50579	DL-707-811	REF		

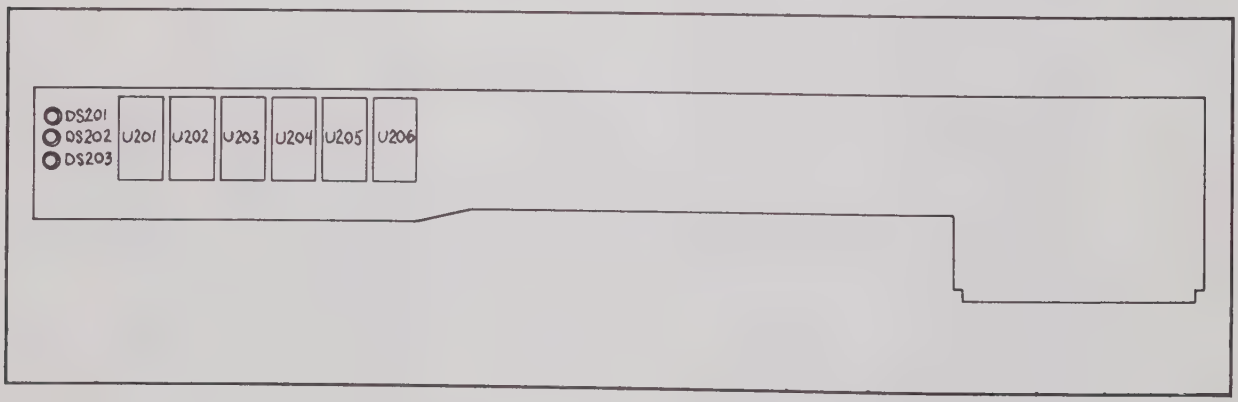

Figure 5-5. DISPLAY PCB ASSEMBLY

INVERTER PCB ASSEMBLY 2

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	INVERTER PCB ASSEMBLY 2 **Figure 5-6**	388447	89536	388447	REF		
C401	Cap: 1900A-01 115V, 6uF ±5%, 200V 1900A-01 100V, 10uF ±5%, 200V 1900A-01 230V, 5uF ±5%, 200V	393546 380261 380253			1 1 1		
C402	Cap, fxd cer, 47pf ± 20%, 100V	369132	56289	C030B102H4705	1		
C403	Cap, Ta, 10uf ±20%, 15V	193623	56289	196D106X0015JA1	1		
C404	Cap, fxd cer, 0.1 uf, 25V	369199	71590	UK-25-104	1		
C405	Cap, elect, 10,000 uf, 6V	387241			1		
CR401	Diode, Si, rect	343491	11711	1N4002	2		
CR402	Diode, Si, rect	343491	11711	1N4002	REF		
CR403	Diode, zener	291575	12969	UZ8720	2		
CR404	Diode, zener	291575	12969	UZ8720	REF		
F1	Fuse, ½ amp, 250V	109322	71400	MDL	1		
Q401	Xstr, Si, NPN	369678	01295	T1S98	2		
Q402	Xstr, Si, NPN	369678	01295	T1S98	REF		
R401	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	1		
R402	Res, comp, 22Ω ±5%, ¼W	147884	01121	CB2205	1		
R403	Res, comp, 330Ω ±5%, ¼W	147967	01121	CB3315	1		
R404	Res, comp, 82Ω ±5%, ¼W	149484	01121	CB8205	1		
T2	Xf mr	372011	89536	372011	1		
L1	Coil	320911	89536	320911	1		

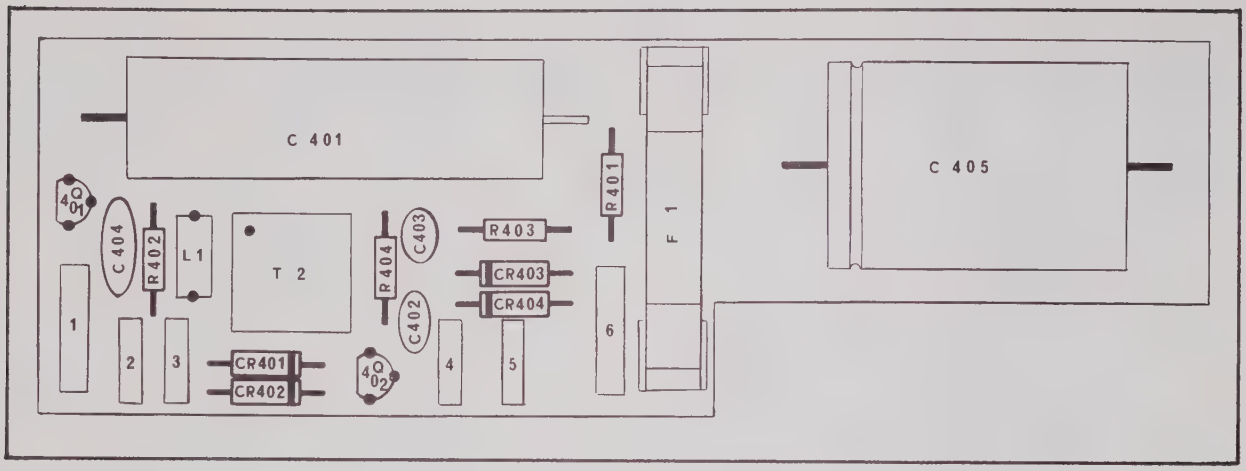

Figure 5-6. INVERTER PCB ASSEMBLY

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the options and accessories available for your instrument. Each option and accessory is described under a separate major heading containing the model or option number. The option descriptions contain applicable operating and maintenance instructions, and field installation procedures. A list of replaceable parts and the schematics are located in Sections 5 and 8 respectively.

6-3. BATTERY PACK, OPTION –01

WARNING

Damage may result if alkaline, zinc-carbon, or mercury batteries are charged in the 1900A.

6-4. Power for the Model 1900A-01 is supplied by internal rechargeable batteries that allow the instrument to operate for at least four hours. The batteries should be recharged after every four hours of operation or when the input sensitivity falls below specifications. Recharging is most rapidly accomplished by switching the 1900A power switch to the OFF position and connecting the instrument to ac line power. In this way, the discharged batteries can be completely recharged in approximately 12 to 14 hours. The instrument can also be operated when recharging the batteries, but the recharging time will be extended to approximately 56 hours.

NOTE

Battery manufacturers recommend that nickel-cadmium batteries not be stored for extended periods of time without recharging at least every 90 days. Storage temperature below 25°C are recommended.

6-5. Battery Replacement

6-6. The procedure described below provides step-by-step instructions for replacing the batteries in the Model 1900A-01.

CAUTION

Do not remove the batteries before disconnecting the instrument from input line power.

a. Disconnect line power cord. Remove retainer screw from rear of instrument case, and remove instrument from case.

b. On the underside of PCB, remove two threaded bolts securing battery holders in place.

c. Remove holder tops and batteries.

d. Replace batteries with 1.2 volt nickel-cadmium batteries (JF part no. 346924). Install the batteries adhering to polarity indications on battery holder.

NOTE

Use 1.2 volt nickel-cadmium batteries only.

6-7. Battery Powered Instrument Repair Techniques

6-8. In battery-powered instruments, one of the batteries should be removed before attempting any repairs. This is necessary to eliminate the danger of shorting portions of the circuitry which carry the battery voltage. Remove the batteries as described under Battery Replacement.

6-9. DATA OUTPUT UNIT, OPTION –02

6-10. Introduction

6-11. The Fluke Model 1900A counter, when equipped with a Data Output Unit is compatible with data logging systems which accept parallel bits of information in binary coded decimal (1, 2, 4, 8) format. The data available from the counter contains digit, overflow, decimal point, units, and print command information. The drive capability of all data outputs in CMOS compatible; able to sink .16mA at logic 0 or source .16mA for logic 1 levels.

6-12. Operation

6-13. OUTPUT DATA

6-14. The output data available at the rear-panel D.O.U. connector is listed in Table 6-1. The pin functions and decimal point code are provided.

6-15. D.O.U. 44 PIN CONNECTOR KIT

6-16. A 50 pin connector kit is provided to allow custom fabrication of an interface cable. The kit (JF part no. 410241) consists of the following items:

ITEM	DESCRIPTION	QUANTITY	FLUKE P/N
1	Connector, 50 pin	1	407320
2	Connector Backshell	2	398008
3	AMP pins	38	394569
4	Polarizing Key	1	386169
5	Form	1	433425

The interconnecting cable (telephone type D-50) and the termination connector for making the custom interface cable are customer supplied. The 50-conductor, telephone type D-50 cable (Fluke P/N 320317) can be ordered from the John Fluke Mfg. Co.; when doing so indicate how many feet are required.

Table 6-1. DATA OUTPUT UNIT (D.O.U.) CONNECTIONS

PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	–	A	Ground
2	Print Command	B	–
3	–	C	–
4	–	D	–
5	–	E	–
6	Overflow	F	Decimal Point (L)
7	Decimal Point (M)	H	Decimal Point (N)
8	LSD – BCD 8	J	LSD – BCD 4
9	LSD – BCD 2	K	LSD – BCD 1
10	5SD – BCD 8	L	5SD – BCD 4
11	5SD – BCD 2	M	5SD – BCD 1
12	4SD – BCD 8	N	5SD – BCD 4
13	4SD – BCD 2	P	4SD – BCD 1
14	3SD – BCD 8	R	3SD – BCD 4
15	3SD – BCD 2	S	3SD – BCD 1
16	2SD – BCD 8	T	2SD – BCD 4
17	2SD – BCD 2	U	2SD – BCD 1
18	MSD – BCD 8	V	MSD – BCD 4
19	MSD – BCD 2	W	MSD – BCD 1
20	MHz	X	μS
21	kHz	Y	mS
22	Hz	Z	Dimensionless *

*Goes high in TOTALIZE function.

DECIMAL POINT POSITION CODING

(L) Pin F	(M) Pin 7	(N) Pin H	DECIMAL POINT POSITION
0	0	0	XX.XXXX
1	0	0	XXX.XXX
1	0	1	XXXX.XX
0	0	0	– – –

6-17. Theory of Operation

6-18. The D.O.U. consists of a series of latches which, when enabled, store the digit, decimal, and unit information. The stored data is updated at each 1953A gate time. The memory update command (MUP), used to update the data stored in the latches in U24, also generates the trigger at pin 2 of the DOU connector. The trigger (1ms positive pulse) indicates that new data is being loaded; the D.O.U. output data should be ignored during this time.

6-19. The display data is applied to the D.O.U. in bcd format (1, 2, 4, 8) on J3 pins 1, 16, 10 and 9 respectively (see Data Output Unit Schematic, Section 8). The bcd equivalent of each digit of the display, least significant (LSD) through the most significant (MSD), is strobed on to the four lines for 90 ms each. The strobe signal that applies each significant digit to the four data lines also enables a latch in the D.O.U. which corresponds to the significant digit information on the four data lines. The decimal point code (L, M, N) is produced by nand gates using the decimal strobe (DS) along with digit strobe AS2, AS3, or AS4.

6-20. LIST OF REPLACEABLE PARTS

6-21. The following is a list of replaceable parts for the Data Output Unit, Option –02. Refer to Section 5 for an explanation of the column entries. The component locations are illustrated in Figure 6-1.

D.O.U. PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DOU PCB ASSEMBLY **Figure 6-1**						
C1	Cap, elect, 22uF ±20%, 20V	357780	56289	196D226X0020 LA3	1		
C2	Cap, cer, 68 pF ±10%	106153			1		
C3	Cap, fxd cer, 0.1 uF, 25V	369199	71590	UK-25-104	1		
R1	Res, comp, 47K ±5%, ¼W	148163	01121	CB4735	1		
R2	Res, comp, 100K ±5%, ¼W	148189	01121	CB1045	1		
U1, U3, U4	IC, C-MOS, Nand Gates	355198	04713	MC14011CP	3		
U2	IC, C-MOS, Dual Multivibrator	393512	04713	MC14528CD	1		
U5, U7 thru U12	IC, C-MOS, Quad Clocked D Latch	355149	95303	CD4042	7		
U6	IC, C-MOS, BCD-to-Decimal Decoder	380741	95303	CD4028AE	1		

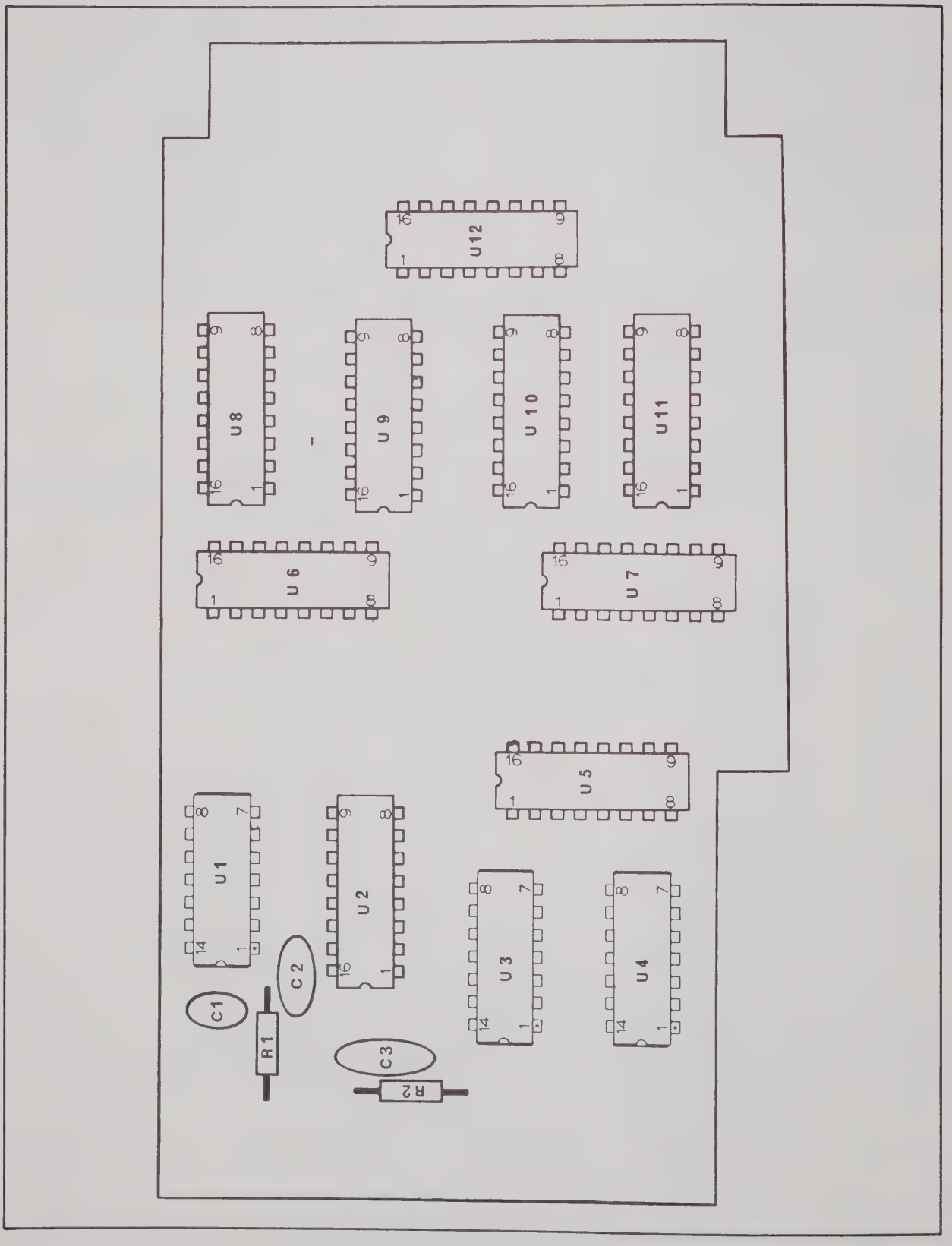

Figure 6-1. D.O.U. PCB ASSEMBLY

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the Lists of Replaceable parts contained in Section 5. The following information is presented in this section:

TABLE	TITLE	PAGE
7-1.	List of Abbreviations	7-2
7-2.	Federal Supply Codes for Manufacturers	7-3
7-3.	Fluke Technical Service Centers	7-7
7-4.	International Service Centers	7-7
7-5.	Sales Representatives-Domestic	7-8
7-6.	Sales Representatives-International	7-9

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(—) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

Table 7-3. FLUKE TECHNICAL SERVICE CENTERS

United States

CALIFORNIA

Burbank
Fluke Western Tecnical Center
Mike Nagy, Service Manager
2020 N. Lincoln St.
Zip: 91504
Tel. (213) 849-4641

Santa Clara
Fluke Western Technical Center
Tom Marshall, Service Manager
2359 De La Cruz Blvd.
Zip: 95050
Tel. (408) 985-1200

COLORADO

Denver
Fluke Southwestern
Technical Center
Mel Suelzle, Service Manager
1980 S. Quebec St.
Unit 4
Zip: 80231
Tel. (303) 750-1228

FLORIDA

Orlando
Fluke S.E. Technical Center
Jesse Morse, Service Manger
P.O. Box 6578
940 N. Fern Creek Ave.
Zip: 32803
Tel. (305) 896-2296

ILLINOIS

Des Plaines
Fluke Midwestern
Technical Center
Bruce Hunt, Service Manager
1287 N. Rand Road
Zip: 60016
Tel. (312) 298-7470

MARYLAND

Kensington
Fluke Mideastern
Technical Center
John Hines, Service Manager
11501 Huff Court
Zip: 20795
Tel. (301) 881-5300

MASSACHUSETTS

Lexington
Fluke N.E. Technical Center
Dick Zemba, Service Manager
109 Massachusetts Ave.
Zip: 02173
Tel. (617) 861-8620

MINNESOTA

Minneapolis
Fluke Midwestern
Technical Center
Robert Wayne, Br. Manager
10800 Lyndale Ave. So.
Zip: 55420
Tel. (612) 884-4541

NEW JERSEY

Totowa
Fluke Eastern Technical Center
Al La Fleur, Service Manager
500 Union Blvd.
Zip: 07512
Tel. (201) 742-3215

NEW YORK

Farmingdale, LI
Fluke Eastern Technical Center
Charles Vanek, Br. Manager
59Central Ave. Unit 3
Zip: 11735
Tel. (516) 752-1078

Rochester
Fluke Eastern Technical Center
Wayne Roth, Br. Service Manager
4515 Culver Road
Zip: 14622
Tel. (716) 342-6940

NORTH CAROLINA

Greensboro
Fluke S.E. Technical Center
Dwain Cox, Service Manager
P.O. Box 9619
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

WASHINGTON

Mountlake Terrace
John Fluke Mfg. Co., Inc.
Bill Fetrow, Tech. Service Spvr.
7001 - 220th Ave. S.W.
Zip: 98043
Tel. (206) 774-2206

Canada

ALBERTA

Calgary
Fluke Canadian Technical Center
Dave Racinsky, Service Manager
3829 - 12th St. N.E.
Zip: T2E 6M5
Tel. (403) 261-0780

ONTARIO

Mississauga
Fluke Canadian Technical Center
Herb Duval, Service Manager
6427 Northam Drive
Zip: L4V 1J5
Tel. (416) 678-1500

Table 7-4. INTERNATIONAL SERVICE CENTERS

CENTRAL & SOUTH AMERICA

ARGENTINA

Coasin S.A.
Miguel Volpe, Service Manager
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 523185

BRAZIL

Ambriex S.A.
Col. Josue Dantas Martins Filho
Rua Ceara, 104 - 2° e 3° Andares
ZC-29
Rio de Janeiro GB, Brazil
Tel: 264-7406

Adolfo Toyomaro Ichiki,
Service Manager
Rua Tupi, 535
01233 **Sao Paulo SP,** Brazil
Tel: 52-7806 & 0912

ECUADOR

Proteco Coasin CIA, Ltda.
Ing Jaime Jaramillo
Apartado 228A
Quito, Ecuador
Tel: 526759

MEXICO

Mexitek, S.A.
Enrique Batista Mangas,
Service Manager
Eugenia 408
Department 1
Mexico 12, D.F
Mexico
Tel. 5360910 - 5239751

VENEZUELA

Coasin C.A.
Leslie Dunia, Service Manager
Apdo. Postal 50939
Sabana Grande No 1
Caracas 105, Venezuela
Tel: 722311 - 728662

EUROPE

FRANCE

M.B. Electronique S.A.
Serge Pison, Service Manager
29, Rue Emile Duclaux
92150, **Suresnes,** France
Tel: 7723111 (108)

NETHERLANDS

C.N. Rood N.V.
Sieb Hoekstra, Service Manager
Cort van der Lindenstraat 11-13
P.O. Box 42
Rijswijk ZH 2100
Tel: 070-996360

Fluke (Nederland) B.V.
Henk Lit, Service Manager
P.O. Box 5053
Zevenheuvelenweg 53
Tilburg, Netherlands
Tel: (13) 673973

NORWAY

Morgenstierne & Co. A/S
Finn Schjervan
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 472 356110

UNITED KINGDOM

Fluke International Corporation
Ed Cutter, Service Manager
Garnet Close
Watford, WD2 4TT
England
Tel: 0923-33066

AFRICA, ASIA & AUSTRALIA

AUSTRALIA

Elmeasco Instruments Pty. Ltd
Andrew McKean,
Service Manager
P.O. Box 30
Concord, N.S.W
Australia 2137
Tel: (02) 736-2888

HONG KONG

Gilman & Co., Ltd.
J.B. Tetlow
P.O. Box 56
Hong Kong
Tel: 227011 (14)

INDIA

Hinditron Services Pvt. Ltd.
Chandu Vagal,
Service Manager
69/A.L. Jagmohandas Marg
Bombay —400 006, India
Tel: 365344

IRAN

Berkeh Company Ltd.
Tom Payne
20 Salm Road, Roosevelt Ave.
Tehran, Iran
Tel: 828294 831564

ISRAEL

R.D.T. Electronics Engineering Ltd.
Shamai Ram-nof,
Service Manager
46, Sokolov Street
Ramat Hasharon 47235 Israel
Tel: 483211

JAPAN

Toyo Trading Company Ltd.
Mr. Adachi, Service Manager
P.O. Box 5014
International Tokyo
Tokyo 100-31, Japan
Tel: (03) 279-0771

SOUTH AFRICA

Fluke (Pty) Ltd.
P.O. Box 13091
Benoni 1511
Transvaal
Republic of South Africa
Tel: 011-849-6811

For areas not listed, contact the Fluke Technical Center nearest you or contact Fluke directly at Mountlake Terrace, WA

John Fluke Mfg. Co., Inc.
P.O. Box 43210, Mountlake Terrace, WA 98043
Tel: (206) 774-2211 Toll Free: (800) 426-0361 TWX: 910-449-2850 Telex: 32-0013 Cable: Fluke

United States

ALABAMA
Huntsville
BCS Associates, Inc.
P.O. Box 1273
3322 S. Memorial Parkway
Zip: 35807
Tel. (205) 881-6220

ALASKA
Anchorage
Harry Lang & Associates
1406 W. 47th Ave.
Zip: 99503
Tel. (907) 279-5741

ARIZONA
Phoenix
Barnhill Associates, Inc.
7319 E. Stetson Drive
Scottsdale, AZ 85251
Tel. (602) 947-7841

CALIFORNIA
Los Angeles
Instrument Specialists
Sales Group
John Fluke Mfg. Co., Inc.
2020 North Lincoln Street
Burbank, CA 91504
Tel. (213) 849-7181
Santa Clara
Instrument Specialists
Sales Group
John Fluke Mfg. Co., Inc.
2359 De La Cruz Blvd.
Zip: 95050
Tel. (408) 244-1505

COLORADO
Denver
Barnhill Associates, Inc.
1980 S. Quebec Street, Unit 4
Zip: 80231
Tel. (303) 750-1222

CONNECTICUT
Hartford
IRI Sales Group
John Fluke Mfg. Co., Inc.
P.O. Box 518
Glastonbury, CT 06033
Tel. (203) 633-0777

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BCS Associates, Inc.
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940 N. Fern Creek Ave.
Zip: 32803
Tel. (305) 896-4881

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BCS Associates, Inc.
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Zip: 30033
Tel: (404) 321-0980

HAWAII
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Industrial Electronics, Inc.
P.O. Box 135
646 Queen Street
Zip: 96817
Tel. (808) 533-6095

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Cozzens & Cudahy Sales Group
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Des Plaines, IL 60016
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Port O'Call Executive Center
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Zip: 46224
Tel. (317) 244-2456

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Tel. (816) 454-5836

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Valley Station, KY 40272
Tel. (502) 935-9634

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11501 Huff Court
Kensington, MD 20795
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Lexington, MA 02173
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Madison Heights, MI 48071
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Tel. (505) 299-7658

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Tel. (216) 267-0445

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7913 S. Suburban Road
Zip: 45459
Tel. (513) 434-7500

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King of Prussia, PA 19406
Tel. (215) 265-4040

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90 Clairton Blvd.
Zip: 15236
Tel. (412) 892-2953

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1200 Barton Hill, No. 197
Zip: 78704
Tel. (512) 444-2377

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908 Business Parkway
Richardson, TX 75080
Tel. (214) 231-2573

Houston
Barnhill Associates, Inc.
10606 Hempstead Highway
Suite 132
Zip: 77092
Tel. (713) 688-9971

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107 Rich Neck Road
Zip: 23185
Tel. (804) 877-4053

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Zip 99320
Tel. (509) 588-3472

Seattle
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1521 - 130th N.E.
Bellevue, WA 98005
Tel. (206) 455-4922

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Baltimore
John Fluke Mfg. Co., Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-3370

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Allan Crawford Assoc., Ltd.
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Tel. (403) 276-9658

BRITISH COLUMBIA
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Allan Crawford Assoc., Ltd.
116 E. Third St., Suite 203
Zip: V7L 1E6
Tel. (604) 980-4831

NOVA SCOTIA
Halifax
Allan Crawford Assoc., Ltd.
Suite 201, Townsend Pl.
800 Windmill Rd.
Burnside Industrial Park
Dartmouth, NS
Zip: B3B 1L1
Tel. (902) 469-7865

ONTARIO
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Allan Crawford Assoc., Ltd.
6427 Northam Drive
Mississauga, Ont L4V 1J5
Tel. (416) 678-1500
Ottawa
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Zip: K2B 7Y4
Tel. (613) 829-9651

QUEBEC
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Allan Crawford Assoc., Ltd.
1330 Marie Victorian Blvd. E.
Longueuil, P.Q. J4G 1A2
Tel. (514) 670-1212

For Canadian areas not listed, contact the regional office nearest you or Allan Crawford Assoc., Ltd., Mississauga, Ontario.

All of the above Fluke Sales Offices carry local stocks of low-cost Digital Multimeters (Models 8000A, 8030A, 8040A), Counters (Model 1900A), Digital Thermometers (Models 2160A, 2170A, 2165A, 2175A) and the Universal Temperature Probe (Model 80T-150). These same products are available from the following distributors:

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San Diego, CA (714) 565-9171
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Albuquerque, NM (505) 299-8293
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Tel: 222-945646

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B-1040 **Brussels,** Belgium
Tel: 02-27352135

CYPRUS
Chris Radiovision Ltd.
P.O. Box 1989
Nicosia, Cyprus
Tel: 66121

DENMARK
Tage Olsen A/S
Teglvaerksgade 37
DK-2100 **Copenhagen Ø,** Denmark
Tel: 01-294800

FINLAND
Oy Findip AB
Teollisuustie 7
02700 **Kauniainen,** Finland
Tel: 080-502255

FRANCE
M.B. Electronique S.A.
Rue Fourney
ZAC de BUC
B.P. N° 31
78530 BUC, France
Tel: 9563130

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Fluke (Deutschland) GmbH
4-**Dusseldorf**
Meineckestrasse 53
West Germany
Tel: 211-450831

Fluke (Deutschland) GmbH
8000 **Munich** 80
Mutschellestrasse 1
West Germany
Tel: 089-433021

GREECE
Hellenic Scientific
Representations Ltd.
10, Nympheou Street
Athens 615, Greece
Tel: 021-7792320/705960

ISRAEL
R.D.T. Electronics
Engineering Ltd.
46, Sokolov Street
Ramat Hasharon 47235, Israel
Tel: 483211

ITALY
Sistrel S.p.A.
Via Giuseppe Armellini No. 37
00143 **Rome,** Italy
Tel: 5915551

Sistrel S.p.A.
Via Timavo 66
20099 Sesto S. Giovanni (**Milan**)
Italy
Tel: 02-2485233

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Cort van der Lindenstraat 11-13
Rijswijk (Z.H.) 2100
Netherlands
Tel: 070-996360

Fluke (Nederland) B.V.
P.O. Box 5053
Zevenheuvelenweg 53
Tilburg, Netherlands
Tel: (13) 673973

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Konghellegate 3
P.O. Box 6688, Rodelökka
Oslo 5, Norway
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De Laboratorio Ltda.
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SWEDEN
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S-162 **Vallingby**-4
Sweden
Tel: 08-380370

TURKEY
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Necatibey Cad 92/2
Karaköy/**Istanbul**
Turkey
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Fluke International Corp.
Garnet Close
Watford, WD2 4TT, England
Tel: 0923-33066

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Contact: Amtest Associates Ltd., P.O. Box 55, Addlestone, Surrey, KT 15 1DU, England. Tel: 0932-52121.

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Buenos Aires, Argentina
Tel: 523185

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P.O. Box 30
Concord, N.S.W.
Australia 2137
Tel: (02) 736-2888

Elmeasco Instruments Pty Ltd
P.O. Box 107
Mt. Waverly, VIC. 3149
Australia
Tel: 233-4044

BOLIVIA
Coasin Bolivia S.R.L.
Casilla 7295
La Paz, Bolivia
Tel: 40962

BRAZIL
Ambriex S.A.
Rua Ceara, 104-2°. e 3°. Andares
ZC-29
Rio de Janeiro GB, Brazil
Tel: 264-7406

Ambriex S.A.
Rua Tupi, 535
01233
São Paulo SP, Brazil
Tel: 66-0912, 66-5947

CARIBBEAN & CENTRAL AMERICA
West Indies Sales Co.
7360 Northwest 66th Street
Miami, FL 33166
Tel: (305) 592-8188

CHILE
Coasin Chile Ltd.
Casilla 14588—Correo 15
Santiago, Chile
Tel: 396713

CHINA, PEOPLE'S REPUBLIC OF
May Lee Industries, Ca, Inc.
11 Broadway, Suite 1612
New York, New York 10004
Tel: (212) 425-4347

COLOMBIA
Assistec Limitada
Apartado Aereo 12322
Bogotá 1, Colombia
Tel: 419331

ECUADOR
Proteco Coasin CIA, Ltda.
Apartado 228A
Quito, Ecuador
Tel: 526759

EGYPT
Lotus Engineering Organisation
P.O. Box 1252
Cairo, Egypt
Tel: 71617

HONG KONG
Gilman & Co., Ltd.
P.O. Box 56
Hong Kong
Tel: 794266

INDIA
Hinditron Services Pvt. Ltd.
69/A L. Jagmohandas Marg
Bombay 400 006, India
Tel: 365344, 381615

Hinditron Services Pvt. Ltd./
Hinditron Computers Pvt. Ltd.
"Hinditron House"
412 Rajmahal Vilas Extension
Bangalore 560 006, India
Tel: 32852

INDONESIA
P.T. United Dico-Citas Co., Ltd.
JLN Penjaringan 39A
Jakarta, Indonesia
Tel: 21380

IRAN
Berkeh Company Ltd.
20 Salm Road, Roosevelt Avenue
Tehran, Iran
Tel: 828294, 831564

JAPAN
Toyo Trading Company Ltd.
P.O. Box 5014
Tokyo International
Tokyo 100-31, Japan
Tel: (03) 279-0771

Toyo Trading Company, Ltd.
Suzuki Building
2-38 Junkeicho-dori
Minami-ku, **Osaka,** Japan
Tel: (06) 262-3471

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Trading & Agricultural
Development Co.
P.O. Box 567
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Tel: 23052

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City House, Wabera Street
P.O. Box 30635
Nairobi, Kenya
Tel: 31955

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Seoul, Korea
Tel: 76-2761

KUWAIT
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Kuwait, Arabian Gulf
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Contracting Company
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Nsouli Building
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Eugenia 408
Department 1
Mexico 12, D.F., Mexico
Tel: 5360910

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Boulevard Moulay Slimane
Rabat, Morocco
Tel: 276-64

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Lagos, Nigeria

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Electronicas S.A.
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Lima 1, Peru
Tel: 288650

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Marketing Establishment
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Riyadh, Saudi Arabia
Tel: 32700

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Tel: 637944

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Benoni 1511, Transvaal
Republic of South Africa
Tel: 011-849-6811

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Main Road
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3rd Sec.
Taipei, Taiwan
Rep. of China
Tel: 5215252

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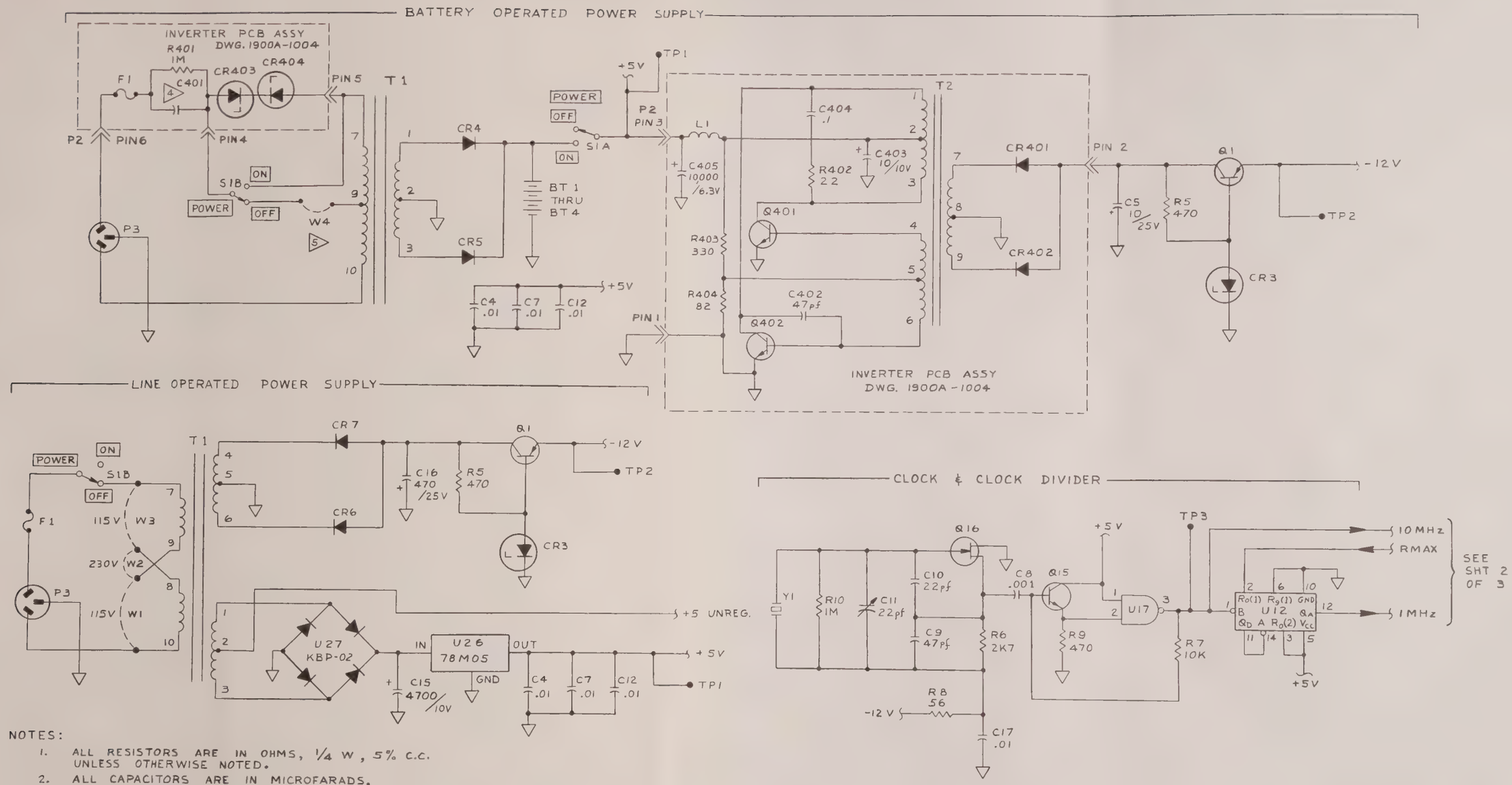
Bankok-11, Thailand
Tel: 914434, 928532

URUGUAY
Coasin Uruguaya S.R.L.
Cerrito 617-4° Piso
Montevideo, Uruguay
Tel: 917978

VENEZUELA
Coasin C.A.
APDO Postal 50939
Sabana Grande No. 1
Caracas 105, Venezuela
Tel: 722311

Section 8
Schematic Diagrams

FIGURE NO.	NAME	DRAWING NO.	PAGE
8-1	Main PCB Assembly (1 of 3)	1900A–1001	8-3
8-1	Main PCB Assembly (2 of 3)	1900A–1001	8-4
8-1	Main PCB Assembly (3 of 3)	1900A–1001	8-5
8-2	Input PCB Assembly	1900A–1003	8-6
8-3	Display PCB Assembly	1900A–1002	8-7
8-4	DOU PCB Assembly	1900A–1005	8-8



NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5% C.C. UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. ALL SWITCHES ARE IN RELEASE POSITION.

4. 6μf/115VAC FOR 115V/60Hz; 5μf/230VAC FOR 230V/50Hz; 10μf/100VAC FOR 100V/50Hz
5. SHORT W4 FOR BATTERY CONFIGURATION
6. IN LINE CONFIGURATION, SHORT W2 FOR 230V, SHORT W1 & W3 FOR 115V.

FIGURE 8-1. (1 of 3) MAIN PCB ASSEMBLY (1900A–1001)

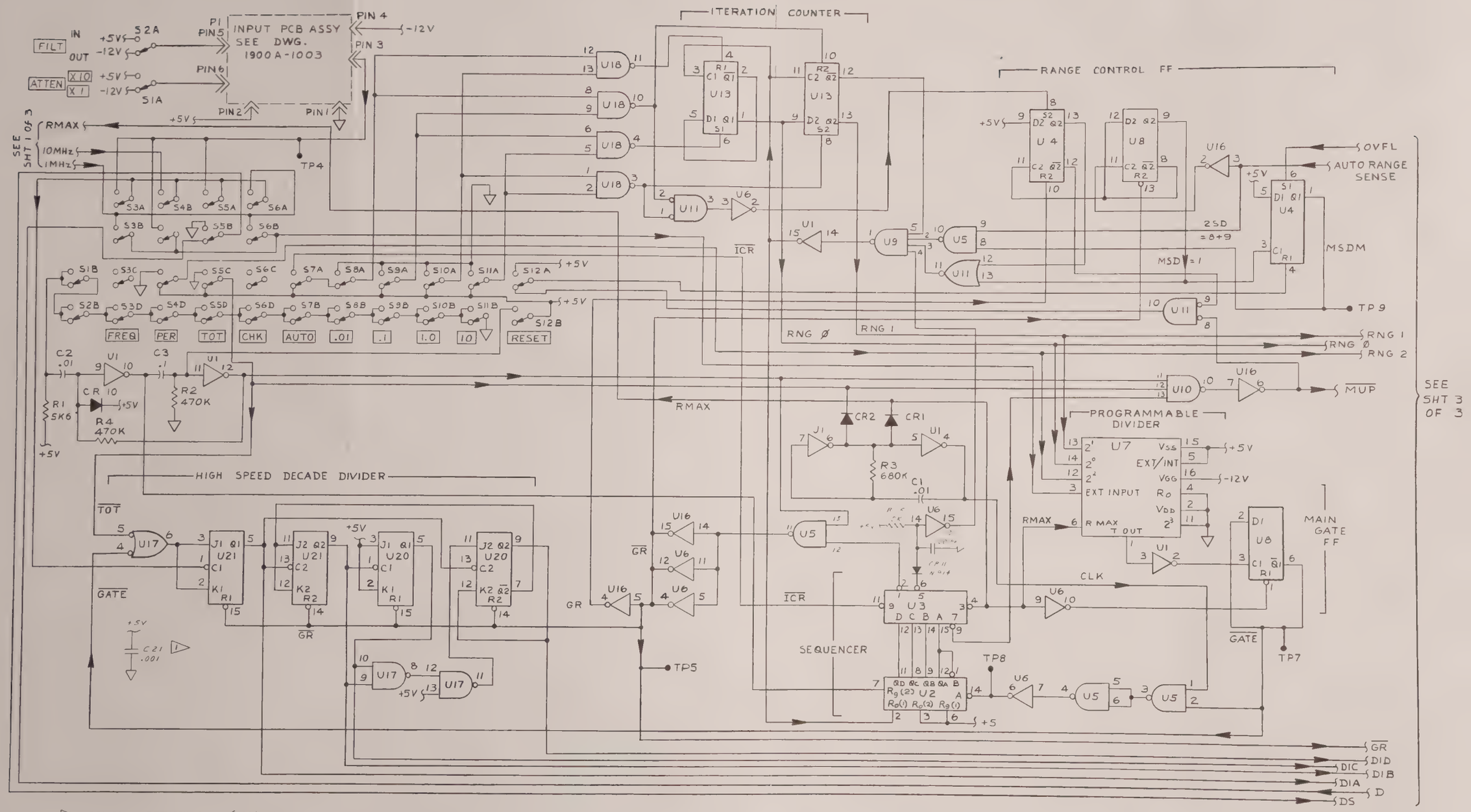
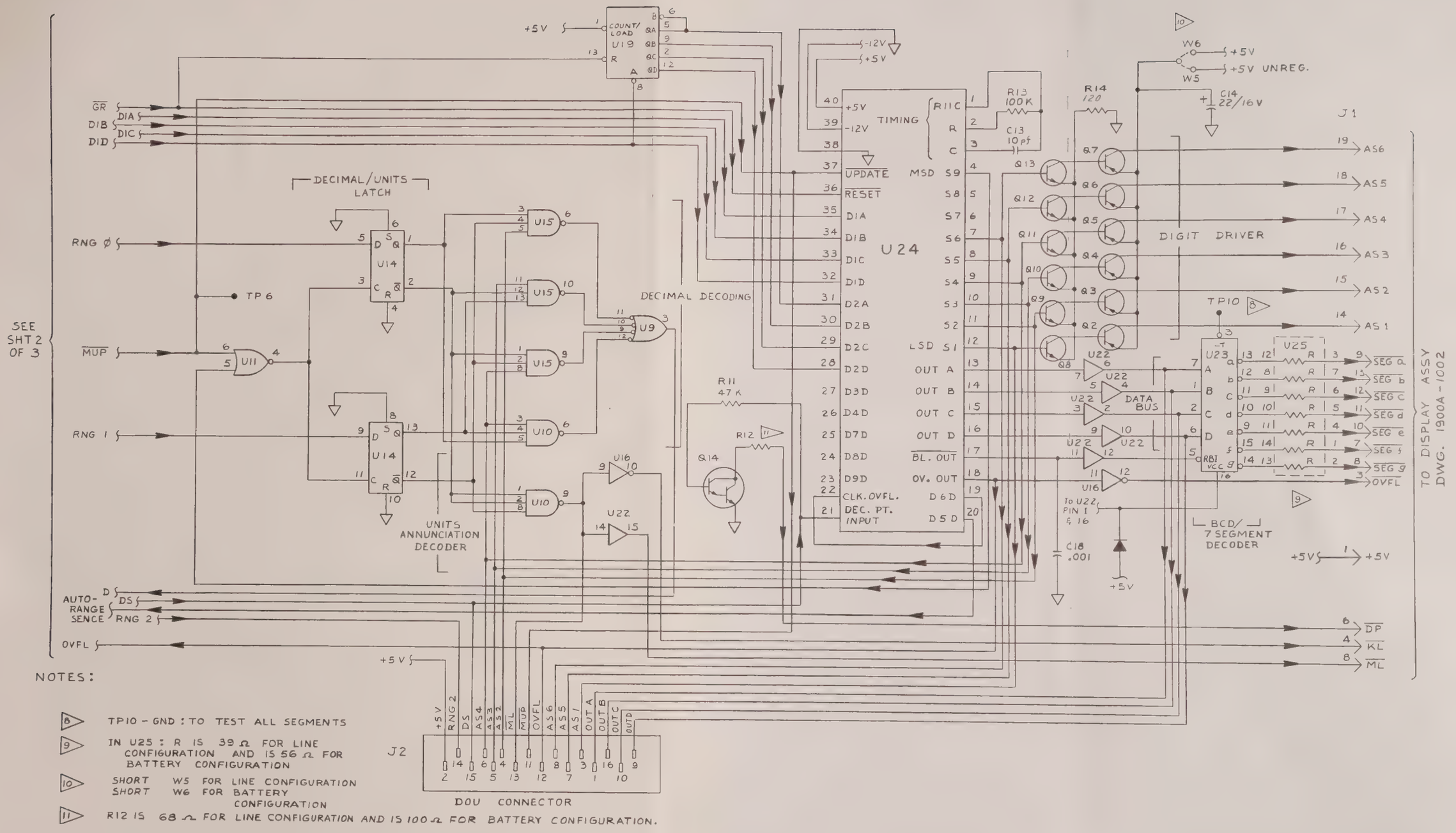


FIGURE 8-1. (2 of 3) MAIN PCB ASSEMBLY (1900A–1001)



NOTES:

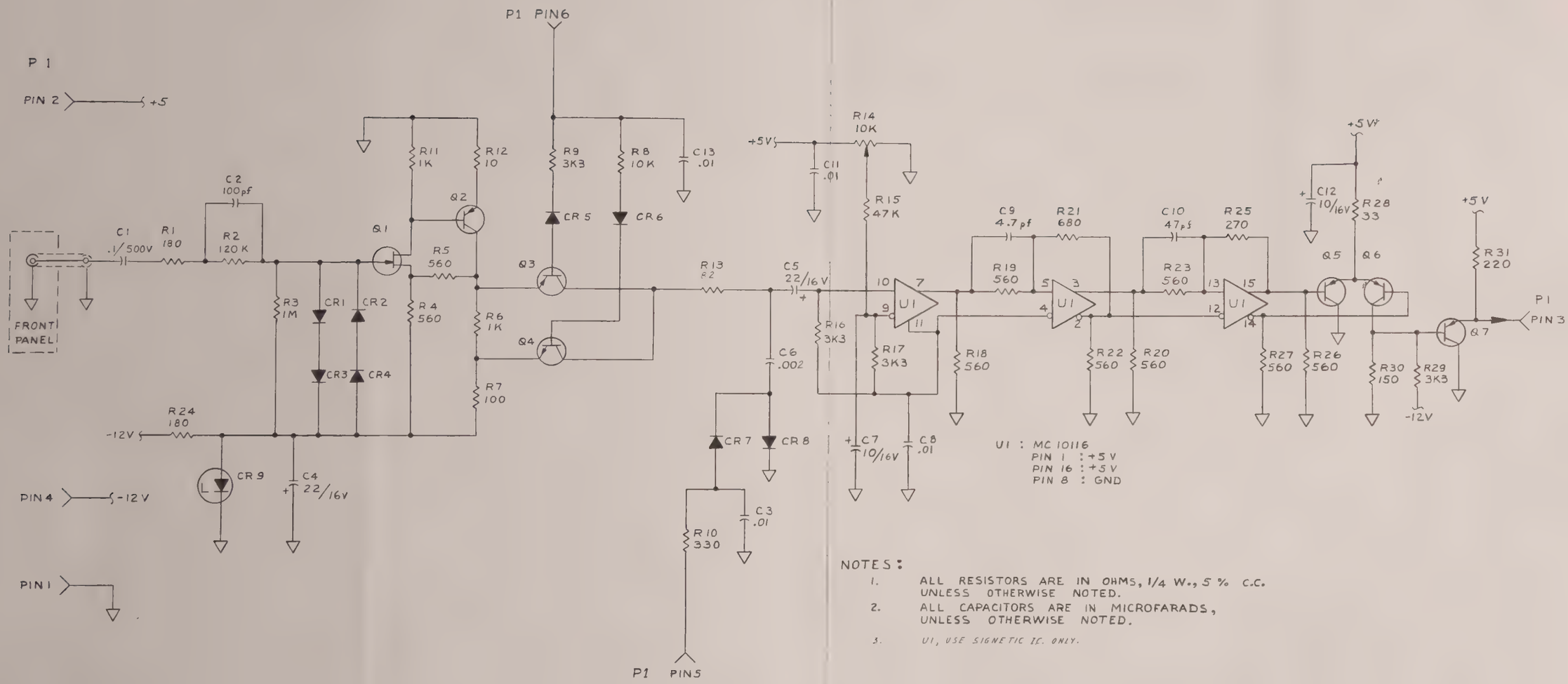
8 TP10 – GND : TO TEST ALL SEGMENTS

9 IN U25 : R IS 39 Ω FOR LINE CONFIGURATION AND IS 56 Ω FOR BATTERY CONFIGURATION

10 SHORT W5 FOR LINE CONFIGURATION
SHORT W6 FOR BATTERY CONFIGURATION

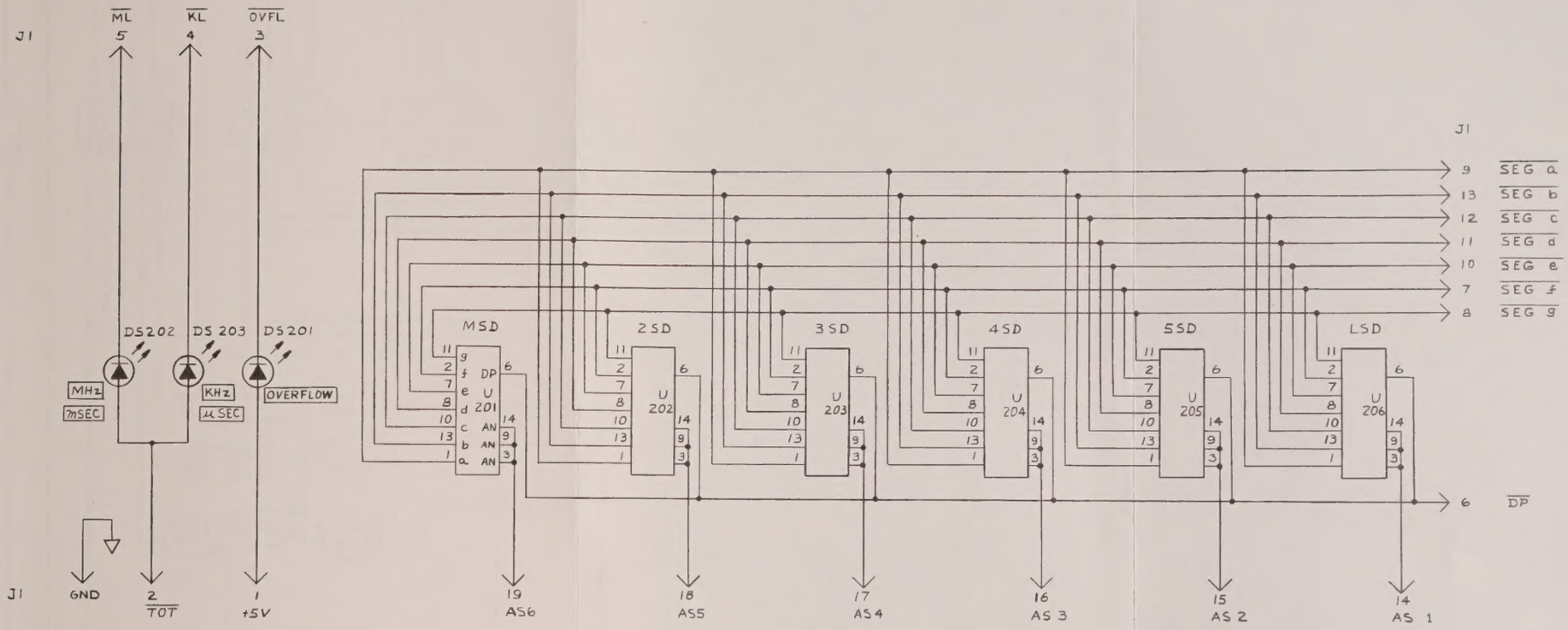
11 R12 IS 68 Ω FOR LINE CONFIGURATION AND IS 100 Ω FOR BATTERY CONFIGURATION.

FIGURE 8-1. (3 of 3) MAIN PCB ASSEMBLY (1900A–1001)



NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4 W., 5 % C.C. UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. U1, USE SIGNETIC IC. ONLY.



NOTE :

1. U201 THRU U206 CONTAIN A SEVEN SEGMENT LED DISPLAY

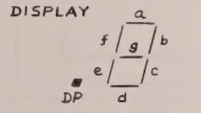
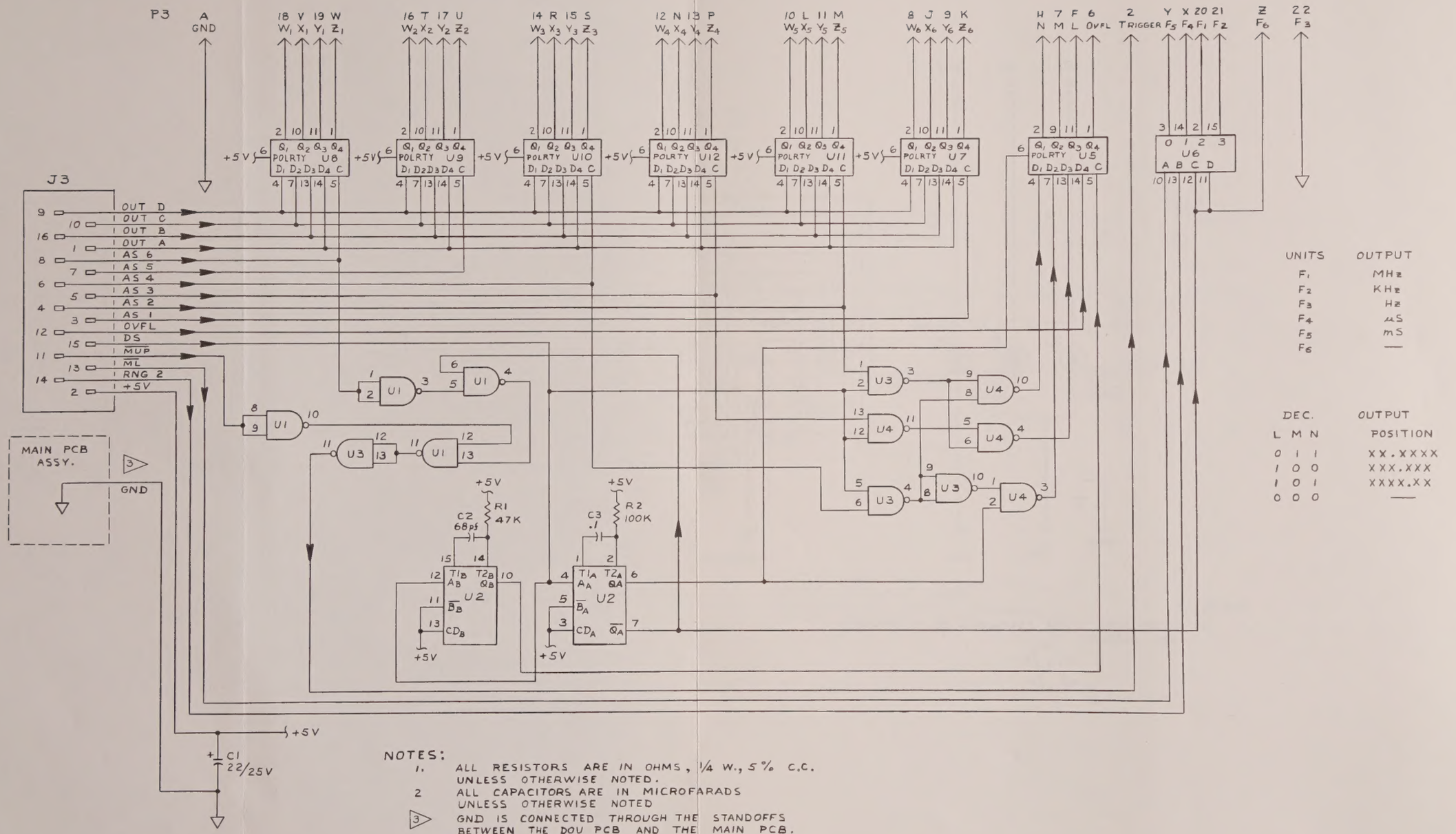


FIGURE 8-3. DISPLAY PCB ASSEMBLY (1900A–1002)



NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4 W., 5% C.C. UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED
3. GND IS CONNECTED THROUGH THE STANDOFFS BETWEEN THE DOU PCB AND THE MAIN PCB.

FIGURE 8-4. DOU PCB ASSEMBLY (1900A–1005)

24454